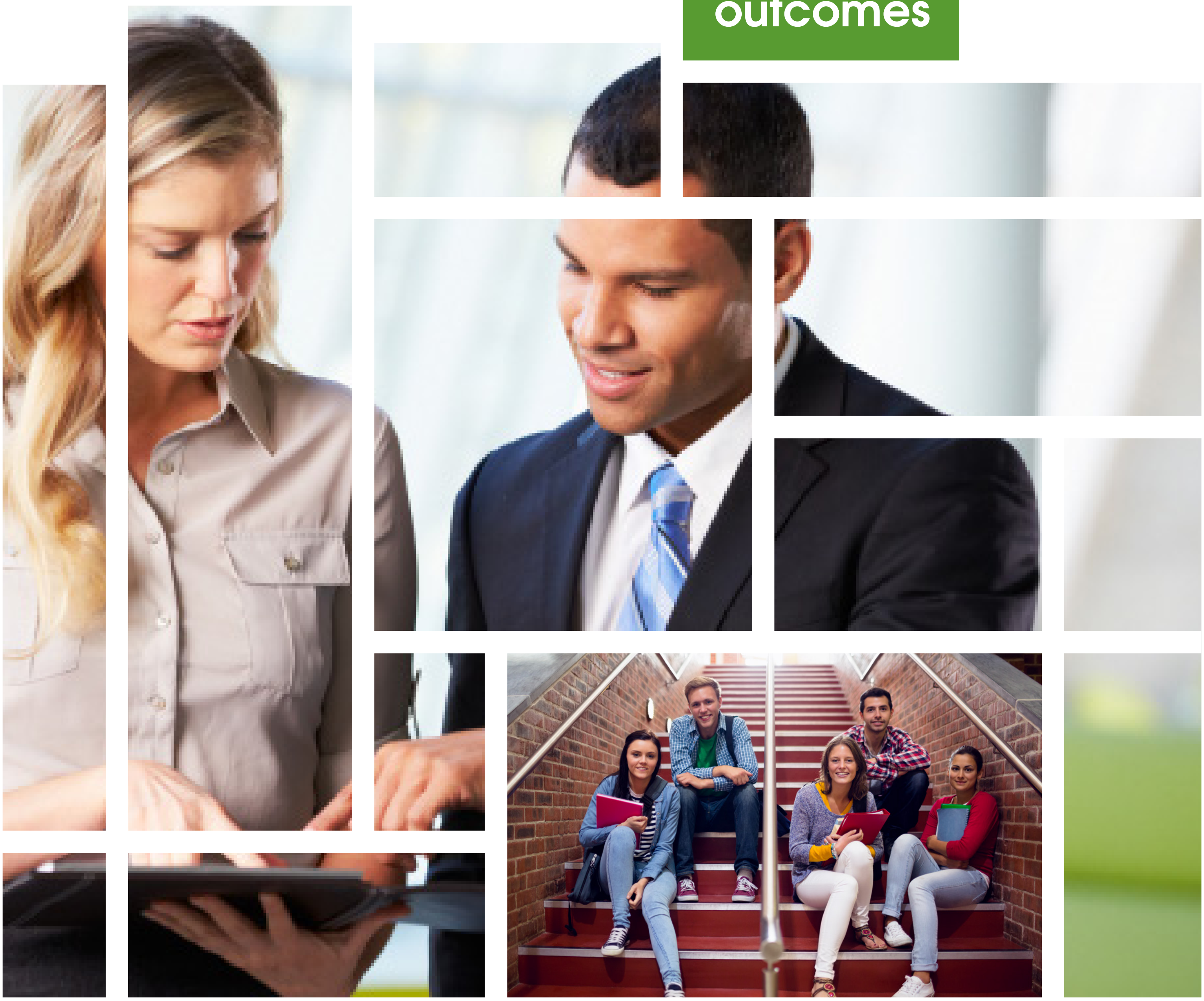
Accreditation of chemical engineering programmes

A guide for higher education providers and assessors

Based on learning outcomes



Preface

IChemE's mission is to advance chemical engineering for societal benefit, worldwide. Through its conduct of higher education programme accreditation, IChemE aims to recognise and share good practice in the education of chemical engineers. At the same time, it seeks to promote development of the profession by encouraging innovation in chemical engineering programme design and delivery.

IChemE's accreditation guidelines derive from long experience in accrediting degree and diploma programmes across the world, against discipline-based criteria. Accreditation serves two purposes: (i) recognition of programmes against IChemE standards; and (ii) linkage to IChemE's suite of professional engineering registrations.

Through the strengths of its standards and quality of its processes, IChemE is licensed by the UK Engineering Council, a Signatory of the International Engineering Alliance, to accredit higher education degrees and other qualifications against defined criteria set out in UK-SPEC[*]. The accreditation process involves scrutiny of evidence provided by the higher education institution and a visit to ensure that the programmes comply with the guidelines in this document. IChemE accredited programmes are recognised through mutual recognition agreements worldwide.

IChemE would like to extend its sincere appreciation to the many people from industry and academia who have assisted in its worldwide accreditation activities, and who have helped in preparing this revision of the guidelines.

Application and Supporting documents

Application documents available at http://www.icheme.org/accreditation/university-accreditation/application.aspx include: Assessment questionnaires/report forms; Credit analysis tools; SH&E covering notes; SH&E checklist; and Checklist for design portfolios in chemical engineering programmes.

Supporting documents available at http://www.icheme.org/accreditation/university-accreditation/supporting.aspx include: Assessor Code of Conduct; Appeals procedure; and Accreditation cost recovery (inc. benchmarking).

[*] *UK Standard for Professional Engineering Competence, available from* http://www.engc.org.uk/ukspec.aspx
See also "The Accreditation of Higher Educational Programmes", available from http://www.engc.org.uk/education-skills/accreditation-of-higher-education-programmes/

Document Control

Version No.	Date issued	Changes
V2.0	11 Aug 2017	Revised Final, incorporating: Amendments to Sections 5.2 (Table 6), 5.8, 7.4.2 and 8.1 to reflect introduction of VAP processes. Text added to 8.2.2 on handling of conditions. Minor revision to Visit Schedule Appendix D. Decision criteria added to Appendix E. Backdating added to 8.2.3. Cross references to new supporting document: Accreditation cost recovery (including benchmarking) in 5.4, 5.9 and 10.1. Cross references to new Professional Process Safety Engineer accreditation documents in Introduction and Section 2. Cross references to new Joint Visit protocol in Section 9. New supporting document added to website: Checklist for design portfolios in chemical engineering programmes
V1.2	25 Nov 2015	Text amendment on page 10 (before Table 5). Added 'uncontrolled' caveat to footer. Corrected page numbering error. Updated and moved document control table to record change history details. References to Annexes I, II, etc, replaced with web link to supplementary documents.
V1.1	15 Oct 2015	Supplementary documents section amended on page 2
V1.0	Sep 2015	Final revision, inc App B

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Appendices

1. Introduction

> "Modern society relies on the work of chemical, biochemical and process engineers - they help manage resources, protect the environment and control health and safety procedures, while developing the processes that make the products we desire or depend on.
>
> Chemical engineering is all about changing materials into useful products used every day in a safe and cost effective way. For example petrol, plastics and synthetic fibres such as polyester and nylon, all come from oil.
>
> Chemical engineers understand how to alter the chemical, biochemical or physical state of a substance, to create everything from face creams to fuels." *

Chemical engineering continues to evolve rapidly as a profession. Nowhere is the need to take account of change more important than in the education and academic formation of engineers. It is essential that new graduates have the skills to perform in an ever-wider variety of roles and industries. Moreover, they must not only be equipped to contribute quickly during their early careers, but also have a quality academic grounding in chemical engineering principles 'to last a lifetime' and to enable them to contribute to solving the challenges such as identified in Chemical Engineering Matters[†]

Our aim, to recruit the brightest and most innovative people into the discipline of chemical engineering, challenges us to provide them with an education that will stimulate and develop their talents. Higher education degree and diploma programmes must communicate the relevance and excitement of our profession. IChemE responds to this challenge with its accreditation activity, through which educators benefit from our knowledge of excellent global practice in chemical engineering education. IChemE concentrates upon assessment of 'learning outcomes' (i.e. what is learnt by students) rather than programme content (i.e. what is taught to students).

These guidelines summarise what IChemE requires of an accredited degree or diploma programme, with the intention of leaving it to the university[‡] to determine how the requirement is met. [§]

1.1 The value of accreditation – why universities seek IChemE accreditation

Fundamentally, IChemE accreditation provides benchmarking of academic programmes against high, internationally recognised standards. This is of increasing importance as the globalisation of engineering products and services demands greater confidence by employers in the skills and professionalism of the engineers they recruit.

A department with successfully accredited programmes:

- Benefits from an intensive professional consultation on the programmes.
- Has demonstrated that their programmes are academically sound and industrially relevant.
- Will be able to promote the accreditation status of its degree and diploma programmes publicly.
- Benefits from academic exchange within the IChemE community of universities having accredited programmes.
- Gains access to an international chemical engineering teaching community with opportunities for sharing good practice and progressing challenging issues.
- Is eligible to participate in prestigious awards programmes such as those focussing on excellence in teaching and on design projects.
- Will be able to offer students exchanges with other accredited departments knowing that the student experience will be of high quality and being able to ensure that such students' academic formation meets IChemE's requirements for professional qualification.

Graduates, themselves, strongly benefit from attending accredited programmes as accreditation links closely to professional qualification with IChemE (see Section 2.2). Our aim is to help chemical engineers who acquire sufficient knowledge, understanding and skills to enable them to seek recognition either as a Chartered Chemical Engineer (MIChemE), the highest international qualification for professional chemical engineers, or as an Incorporated Chemical Engineer (AMIChemE).

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[*] http://www.whynotchemeng.com/information

[†] Chemical Engineering Matters, 2nd Ed, IChemE 2014

[‡] Please note that the term "university" is used for convenience throughout these guidelines to represent all kinds of higher educational establishment including polytechnics and colleges. Likewise, the term "department" is used generically for the academic unit responsible for delivering the programmes under review.

[§] Separate guidelines are available for Accreditation of programmes underpinning recognition as a Professional Process Safety Engineer. For further information contact accreditation@icheme.org

1.2 The IChemE accreditation process

IChemE accreditation is a high value, confidential, discipline-specific peer review by a small panel of experienced professional chemical engineers drawn from industry and academe. It is a joint enterprise in which the IChemE panel and the university department seek understanding through mutually respectful discussion of the available evidence. The process is intended to benefit the university, students, employers, IChemE and the wider public.

The appointed assessment panel undertakes an in-depth review of chemical engineering programmes against the criteria published in these guidelines. The panel reviews documentary material relating to the programmes and visits the department for discussions with staff and students. The assessors produce a confidential written report for IChemE and which is made available to the department. Individual comments will be non-attributable in the report. IChemE evaluates the report to decide the accreditation status of the programmes reviewed.

IChemE's accreditation process has many unique strengths which departments value:

- It is a rigorous process that uses panels of three experienced and trained chemical engineering professionals from industry and academia to assess degree and diploma programmes. This provides greater depth and penetration of the teaching programmes than can be achieved by typical alternative pan-engineering accreditation processes.
- It is international in outlook and practice.
- It is recognised and respected worldwide. IChemE has accredited programmes across the world for over 50 years and currently accredits over 200 programmes across 13 countries.
- It is modern and innovative. Concepts of sustainability and ethics, appreciation of the bio interface, quality delivery of transferable skills etc are therefore expected.
- It assesses programmes against the Learning Outcomes achieved by students, regardless of programme title and programme duration.
- It is grounded in a philosophy of continuous improvement. IChemE expects diversity of provision and seeks to stimulate improvement in chemical engineering education by encouraging new and innovative approaches.

IChemE accreditation requirements and outcome standards are explained in Sections 2-4 of the Guidelines. Full details of the accreditation process are given in Sections 5-9.

1.3 The international perspective

IChemE has an international perspective on chemical engineering education, acquired over many years, and holds a deep understanding of the different types of degree and diploma available to students in many countries.

On an international level, the nomenclature for awards and degree names can be especially confusing. The following highlights some of the issues and defines IChemE's approach for dealing with this.

Around the world, the terms 'Bachelors', 'Masters' and 'Diploma' are commonly used for degree award names. IChemE appreciates that different countries may define these degrees in differing ways:

- Worldwide there are examples of 3, 4, 5 and even 6 year Bachelors programmes.
- Some countries offer programmes which integrate undergraduate and masters level study into a single award and different countries may call such integrated programmes Bachelors, Masters or Diploma.
- Some countries only offer integrated degrees, others offer some or all of the range of integrated, undergraduate, postgraduate and sub-degree awards.
- A Diploma award may be equivalent to an integrated Masters in one country or a sub-degree award in another.

Similarly, IChemE recognises that degrees with various titles can fully meet the requirements for accreditation. Examples which have achieved accreditation include *Chemical Engineering, Biochemical Engineering*, *Food Process Engineering* and *Pharmaceutical Engineering*.

IChemE will therefore, in its assessments, focus on the learning outcomes achieved through study for a qualification and the taught content delivered.

To categorise our accreditation decisions IChemE pays no attention to programme name, title or duration but adopts a simple convention of M-, B-, F- and D-Standard accreditations, as follows in Section 2.

IChemE completely respects the need for national-level accreditation systems and welcomes the fact that agreements, such as the International Engineering Alliance's Washington Accord, provide confidence in the quality of university accreditation processes. The chemical engineering outcomes described in this guidance outline IChemE's standards for accreditation that directly link to professional registration with IChemE. It may be that some degree programmes meeting generic attributes under the Washington Accord will not fully meet IChemE's discipline-specific requirements. For information on joint accreditation visits refer to Section 9.1.

2. Accreditation Standards and the link to Professional Registration

2.1 Standards of accreditation award

IChemE accredits academic programmes to four Standards. Each Standard is defined in terms of:

- a set of learning outcomes (Section 3)
- the level at which these learning outcomes are achieved (Appendix C).

The standards are defined and linked to IChemE membership requirements as follows:

Programmes underpinning registration for Chartered Chemical Engineer (MIChemE):

'M-Standard'

A combination of first and second cycle degrees under the Bologna process

- Recognising integrated degrees of the highest international standards that provide both the solid academic foundation in chemical engineering of a first cycle degree at IChemE outcome Level B, and the advanced chemical engineering knowledge and skills of a second cycle degree at IChemE outcome Level F *.

An IChemE-accredited qualification at M-Standard meets in full the academic requirements for Chartered Chemical Engineer.

'F-Standard'

A second cycle degree under the Bologna process

- Recognising postgraduate degrees, such as MSc, of the highest international standards that provide advanced chemical engineering knowledge and skills at IChemE outcome Level F *.

An IChemE-accredited qualification at F-Standard combined with an IChemE-accredited qualification at B-Standard meets in full the academic requirements for Chartered Chemical Engineer.

Programmes underpinning registration for Incorporated Chemical Engineer (AMIChemE):

'B-Standard'

A first cycle degree under the Bologna process

- Recognising first cycle degrees that provide a solid academic foundation in chemical engineering knowledge and skills at IChemE outcome Level B *.

An IChemE-accredited qualification at B-Standard meets in full the academic requirements for Incorporated Chemical Engineer.

An IChemE-accredited qualification at B-Standard may be supplemented by an IChemE-accredited qualification at F-Standard to meet the academic requirements for Chartered Chemical Engineer.

Programmes underpinning registration for Engineering Technician (EngTech):

'D-Standard'

A higher education short cycle programme - within or linked to the first cycle under the Bologna process

- Recognising sub-degree programmes that provide a solid academic foundation in chemical engineering knowledge and skills at IChemE outcome Level D *.

An IChemE-accredited qualification at D-Standard meets in full the academic requirements for Engineering Technician.

* See Appendix C for the IChemE outcome level descriptors

An IChemE-accredited qualification at D-Standard may be supplemented by further learning to B-Standard to meet the academic requirements for Incorporated Chemical Engineer.

2.2 Professional recognition as a Chartered Chemical Engineer or Incorporated Chemical Engineer

Candidates applying for professional registration as a Chartered Chemical Engineer (MIChemE) or Incorporated Chemical Engineer (AMIChemE) need to provide evidence of competency, through the application of knowledge and understanding, and adequate demonstration of professional experience.

- Accredited degrees and diplomas provide graduates with a straightforward way of demonstrating their achievement of the required level of knowledge and understanding, otherwise known as academic formation. Accredited qualifications define the academic formation required for each level of professional membership; a candidate's actual formation may be attained in stages, which taken together match these qualifications.
- Engineers who do not have IChemE-accredited qualifications will need to undergo a full review of academic formation as part of their application for professional registration.

Professional experience is gained in engineering practice, typically after obtaining the academic qualification. Progression between the registration categories is possible and encouraged.

Full guidance on IChemE membership and registration requirements is given at www.icheme.org/membership

See also http://www.getchartered.org/

Chartered Chemical Engineer

The academic formation underpinning eligibility for Chartered Chemical Engineer is an IChemE-accredited 'M-Standard' degree or equivalent in chemical engineering.

Graduates with an M-Standard degree will have met the formal educational requirements for Chartered status membership in full (Path 1 in Table 1 below).

Graduates with a B-Standard degree will normally need to provide evidence of further learning to the equivalent of an M-Standard degree*. This further learning can be achieved through completion of a relevant postgraduate (second cycle) qualification such as an MSc accredited at F-Standard (Path 2 in Table 1). The IChemE 'Further Learning to Masters Level' process provides an alternative route (Path 3 in Table 1).

Graduates will also be required to demonstrate that they have acquired professional competency following a required and sufficient period of relevant training and experience (initial professional development) post-graduation.

Chartered Chemical Engineers (MIChemE) are entitled to register for Chartered Engineer status within the jurisdiction of the UK Engineering Council, and for comparable titles elsewhere, such as Registered Professional Engineer of Queensland in Australia.

**Guidance on achieving Further Learning to Masters Level is available from IChemE.*

Table 1: Academic formation for Chartered Chemical Engineer

Path	*Qualification*		
1	M-Standard degree		
2	B-Standard degree	+	F-Standard degree
3	B-Standard degree	+	Further learning to Masters level

Incorporated Chemical Engineer

The academic formation underpinning eligibility for Incorporated Chemical Engineer is an IChemE-accredited B-Standard degree or equivalent in chemical engineering.

Graduates with a B-Standard degree will have met the formal educational requirements for Incorporated status in full (Path 1 in Table 2).

Graduates with a D-Standard qualification will normally need to provide evidence of further learning to the equivalent of a B-Standard degree (Path 2 in Table 2). This further learning can be achieved through completion of relevant additional academic studies or equivalent.

Graduates will also be required to demonstrate that they have acquired professional competency and commitment to high standards following a period of relevant training and experience (initial professional development) post-graduation. Incorporated Chemical Engineers (AMIChemE) are entitled to register for Incorporated Engineer status within the jurisdiction of the UK Engineering Council and for comparable titles elsewhere, based upon comparative educational standards and professional experience.

Table 2: Academic formation for Incorporated Chemical Engineer

Path	*Qualification*		
1	B-Standard degree		
2	D-Standard qualification	+	Additional academic modules, or further learning to B-Standard

2.3 Recognition as a Professional Process Safety Engineer

The academic formation underpinning eligibility for Professional Process Safety Engineer is an IChemE accredited MSc in Process Safety. Separate guidelines are available for Accreditation of Process Safety MSc programmes.

For further information contact accreditation@icheme.org

3. An accreditation philosophy based upon learning outcomes

3.1 Introduction

IChemE's accreditation decision results from an evidence-based assessment of the learning outcomes delivered by the degree programme and the levels at which these are achieved.

IChemE considers that the quality of a degree or diploma programme is fundamentally dependent on students having a high-quality learning experience which facilitates excellent attainment. This can only be evaluated through review of evidence of student achievement. IChemE therefore believes that measurement of time spent (credit hours) on individual programme or module elements, while providing guidance regarding extent of taught content, is not a definitive measure of learning delivery. Likewise, IChemE believes it can reasonably be expected that cohorts of high entry-standard may, given a stretching curriculum and a demanding, well-resourced teaching environment, be more likely to achieve higher levels of learning outcomes.

IChemE's accreditation philosophy therefore takes into account all factors that influence delivery of learning outcomes.

3.2 About learning outcomes

Learning outcomes define the capabilities of individuals obtaining a qualification. Programme designers typically express them in the form of outcome statements.

A high-level outcome statement might be:

> *"Is able to solve open-ended chemical engineering problems, often on the basis of limited and possibly contradictory information".*

Such an outcome statement can be supported by a cascade of lower-level statements specifying appropriate intellectual abilities, practical skills, general transferable skills etc. This approach provides an effective framework giving both guidance and flexibility to programme designers.

The learning outcomes of a chemical engineering programme will represent the important qualities that IChemE expects the programme to develop in a student who will go on to practise as a chemical engineer. The high-level outcome statements inform the definition of individual module/programme objectives within the degree or diploma. More guidance on this is given later in this section to help those designing or accrediting programmes.

3.3 Scope of chemical engineering degree programmes

The learning outcomes specified in this guidance comprise a package which is distinctive to chemical engineering, and which can be regarded as a minimum necessary requirement for IChemE accreditation.

It is not practical for any one programme to achieve all the learning outcomes that every chemical engineer might conceivably need. However, an acceptable academic formation must prepare graduates for a range of employment roles.

Many degree and diploma programmes will broaden and deepen beyond the minimum requirements in many ways. These could be from within the chemical engineering discipline or through further studies in science or engineering, management, economics, languages or law etc. The quantity of such study will depend on the interests and previous education of the students, as well as the length of the programme. Non-chemical engineering content is referred to as 'complementary subject material'.

Continuously evolving technology and industrial practices mean that higher education programmes cannot equip graduates with all the skills they will need to deploy over an entire career. There will thus always remain a need for continuing professional development (CPD) throughout an engineer's career. Degree and diploma programmes should lay the foundations on which further education, training and professional development can build.

3.4 Entry standards

High quality chemical engineering degree and diploma programmes are demanding on students. While the IChemE accreditation process places greatest emphasis on the outcomes of a programme of study, input standards to the programme invariably remain an important factor. IChemE expects programme providers to maintain appropriate entry standards.

The early part of a chemical engineering programme requires an appropriate and satisfactory standard of knowledge in underpinning mathematics and sciences. IChemE will therefore assess entry standards for the local education system against defined international norms (e.g. as measured by International Baccalaureate, Senior Secondary Certificate of Education, A-levels, etc) and **will expect** the standards for entry to accredited chemical engineering programmes to be at a appropriately high level.

For first degrees and diplomas, IChemE expects prospective students to hold secondary schooling qualifications in underpinning mathematics and sciences above minimum threshold entry standards. Where these criteria are not adequately met, IChemE may require that special measures are in place, such as a foundation year of preparatory study. Such a measure would not be subject to the accreditation review. In other cases, clear evidence of supplementary teaching within the programme will be required.

Many universities admit students directly to year 2 or later in a programme. Such arrangements are often through articulation agreements with other colleges and universities. Departments need to provide evidence that all students meet the overall programme outcomes, regardless of their point of entry.

Considerations comparable to those outlined above apply for entry to postgraduate programmes.

3.5 General learning outcomes

Students graduating from an accredited programme in chemical engineering at all levels must have the general abilities listed below:

Knowledge and understanding: They must be able to demonstrate their knowledge and understanding of essential facts, concepts, theories and principles of chemical engineering and its underpinning mathematics and sciences. They must have an appreciation of the wider engineering context. They must appreciate the social, environmental, legal, ethical, safety, 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. They must be able to propose acceptable (safe, effective, ethical) solutions even when information is lacking.

Practical skills: They must possess relevant practical skills acquired through laboratory work, individual and group project work, in design, and use of software resources. Evidence of group working and of participation in a major substantive project is required.

General transferable skills: They must have developed and demonstrate ability to integrate transferable skills (such as communications, time management, team working, inter-personal, effective use of IT including information retrieval skills) that will be of value in a wide range of situations.

3.6 Learning outcomes in a chemical engineering context

Programmes seeking IChemE accreditation must clearly deliver learning outcomes in each of the following broad areas of learning at the appropriate outcome level (Appendix C):

- **Underpinning Mathematics, Science and Associated Engineering**
- **Core Chemical Engineering**
- **Chemical Engineering Practice**
- **Chemical Engineering Design Practice & Design Projects**
- **Embedded Learning**
- **(F-Standard only) Advanced Chemical Engineering**.

Full details of the learning outcomes in each category are given in Appendix A (for outcome Levels B and F) and Appendix B (for outcome Level D).

The relationship between these learning areas, outcome levels and accreditation standards is shown in Table 3.

3.7 Interpretation of Terms

Within each broad area of learning, it is expected that students will have achieved a number of specific outcomes in terms of 'knowledge', 'understanding', 'skills' and 'awareness'. Advanced, Level F, outcomes may be indicated by descriptors such as 'complex' or 'complexity'.

Consistency in the interpretation of these terms by both assessors and departments will be assisted by the following definitions[1]:

- **Awareness** is general familiarity.
- **Knowledge** is information that can be recalled.
- **Understanding** is the capacity to use concepts creatively, for example: in problem solving; in design; in explanations and in diagnosis.
- **Skills** are acquired and learned attributes that can be applied almost automatically.
- **Complex** implies engineering problems, processes or equipment which involve dealing simultaneously with a sizeable number of factors which interact and require deep understanding, including knowledge at the forefront of the discipline.

[1] As in "The Accreditation of HE Programmes" in UK-SPEC 3rd Ed 2014

3.8 Outcome levels

IChemE defines descriptors for each outcome level in terms of Knowledge, Understanding, Skills and Competence, as shown in Appendix C. Each of the broad outcomes in Section 3.6 should be achieved at the level appropriate to the accreditation standard of programme, as shown in Table 3.

Table 3: Relationship between learning areas, outcome levels and accreditation standards

<table>
<tr><td rowspan="2">Area of Learning</td><td colspan="3">Learning Outcomes
at Levels B & F
(Appendix A)</td><td colspan="2">Learning Outcomes
at Level D
(Appendix B)</td></tr>
<tr><td>Outcome level
(Appendix C)</td><td colspan="2">Accreditation Standard</td><td>Outcome level
(Appendix C)</td><td>Accreditation Standard</td></tr>
<tr><td>Underpinning Mathematics, Science and Associated Engineering
Core Chemical Engineering
Chemical Engineering Practice
Chemical Engineering Design Practice & Design Projects
Embedded learning
Complementary subjects</td><td>Level B</td><td>B-Standard</td><td rowspan="2">M-Standard</td><td>Level D</td><td>D-Standard</td></tr>
<tr><td>Advanced Chemical Engineering (Depth)
Advanced Chemical Engineering (Breadth)
Advanced Chemical Engineering (Practice)
Advanced Chemical Engineering (Design)</td><td>Level F</td><td>F-Standard</td><td colspan="2">Further learning to B-Standard is needed for Incorporated membership</td></tr>
</table>

3.9 Complementary learning

IChemE expects students to also gain the benefits of a rounded education and allows programme designers to have the flexibility to allow students to follow additional beneficial programmes such as languages, management related studies, history and culture.

These complementary studies are not formally assessed by IChemE, but rigour in their teaching and assessment is expected.

4. Design and assessment of programmes for accreditation

4.1 Guidance on duration and content of chemical engineering programmes

4.1.1 Introduction

Decisions on whether a programme is accredited, and at what level, will be taken solely on the basis of evidence of achievement of learning outcomes against defined standards. Accredited programmes may have various titles, content or duration (depending, for example on entry level qualifications) and could be delivered in a wide variety of learning environments and formats (e.g. full-time, part-time, industry-based, distance learning, etc).

Although IChemE seeks to avoid prescription in these aspects, some broad guidance on content is useful for both departments and assessors. However, it should be stressed that the metrics on duration and content given within this section are for guidance. A significant difference from these metrics would not in itself preclude accreditation, but in such cases the department would be expected to justify the differences and provide compelling evidence that the required learning outcomes have been met.

In order to provide a common measure of content, and on the assumption that most programmes have a modular credit-based structure, it has been assumed that a typical year of full-time study comprises the equivalent of 60 credits. It is expected that departments will be able to convert their own measures of programme content to the IChemE credit basis*. As a guide, one IChemE credit is equivalent to approximately 20 hours of student workload (combined teacher-led and independent study). In cases where there are difficulties in interpretation IChemE will provide guidance.

IChemE considers the incorporation of professional engineering approaches and attitudes, through direct contact between educators and students, to be a key component of an effective engineering education. The balance between direct contact and other study activities will vary according to the nature of the module and to local teaching and learning practices.

4.1.2 Minimum programme duration

An indication of the duration and academic credit is shown in Table 4. The indicated values apply to full-time study and for degree entrants meeting IChemE's baseline entry standards for underpinning mathematics and science (see Section 3.4). For part-time or other modes of study, the values should be adjusted in proportion to the amount of study in each year.

Programme duration to a particular accreditation standard will depend on the level of attainment at entry in relation to the requirements of the chemical engineering curriculum. This will vary according to the local school and university education system. However, IChemE stresses that output standards achieved are more important than length of study.

Table 4: Indicative programme duration and credit for full-time study

Programme type	Years of study	IChemE credits
D-Standard	2	120
B-Standard	3	180
M-Standard	4	240
F-Standard	1.5	90

4.1.3 Minimum programme content

IChemE specifies that learning outcomes must be delivered across the broad areas of learning defined in Section 3.6 and the supporting Appendices A and B.

In order to ensure that the Learning Outcomes are met adequately across the broad areas, IChemE provides guidance on the **minimum** expected content for each area and for the programme as a whole. This content is specified in terms of minimum credits, as shown in Table 5.

* NB: the IChemE credit value is equivalent to the European Credit Transfer System (ECTS) credit value.

Frequently, programmes or suites of programmes include various routes and options. These can take a wide variety of forms, including double degrees, joint Honours degrees, programmes with specialisms, programmes with optional modules. In assessing compliance with the minimum requirements, IChemE will look to ensure that the minimum is met for all possible variants which a student might select.

4.1.4 Allocation of Programme Content to Specific Areas

When assessing whether the minimum content has been met for each area of chemical engineering, IChemE will take a holistic and balanced view of the content rather than 'ticking-off' individually each and every learning outcome statement. Within the expected minimum of 85 IChemE credits in total for core chemical engineering, a detailed breakdown for each sub-area is not specified although it is particularly important that the learning outcomes for Process Safety (Appendix A2.6/B2.6) are met in full.

The allocation of the content of a degree programme to specific areas is, for some topics, a matter of judgement. For example:

(a) there is a possible overlap of content between 'Core Chemical Engineering', 'Chemical Engineering Practice' and 'Chemical Engineering Design Practice & Design Projects';

(b) there is a possible overlap of content within Core Chemical Engineering between 'Safety' and 'Sustainability, Economics and Ethics'.

IChemE is generally content to leave this judgement to departments, subject only to clarity with respect to describing which specific areas are included within which headings. The use of minimum total content alongside specified minima for each category provides some latitude for allocation.

The credit analysis tool is available in the Application documents.

Table 5: Learning Outcome areas: minimum credit allocation guidance [1]

Credit basis = 1 credit = 20h combined tutor-led and independent study

	Minimum credit						
Accreditation standard	*M-Standard*		*B-Standard*		*F-Standard*		*D-Standard*
Underpinning Mathematics, Science and Associated Engineering [2]	Appropriate		Appropriate				Appropriate
Core Chemical Engineering [3]	≥85	115	≥85	115			60
Chemical Engineering Practice [3]	≥10		≥10				10
Chemical Engineering Design Practice & Design Projects [3]	≥10		≥10				10
Embedded learning [4]	Sufficient		Sufficient		Sufficient		Sufficient
Advanced Chemical Engineering (Depth) [3]	≥10	60			≥10	60	
Advanced Chemical Engineering (Breadth) [3]	≥10				≥10		
Advanced Chemical Engineering (Practice) [3]	≥10				≥10		
Advanced Chemical Engineering (Design) [3]	≥5				≥5		
Total minimum specified content	**175**		**115**		**60**		**80**
Complementary topics [5]	Balance		Balance		Balance		Balance

Important notes:

*1. **Allocation**: All credit counts are on an exclusive basis. Therefore total content of whole programmes or modules cannot be accounted for twice nor appear under two categories of learning. If departments consider that it is appropriate for content of modules to be allocated across categories of learning, this is acceptable, provided full explanation of rationale is provided to IChemE in the Questionnaire (refer to Page i for links to Additional and Supporting documents)*

*2. **Underpinning Mathematics, Science and Associated Engineering**: The appropriate amount of underpinning material will vary according to the entry achievement of students and the nature of the programme itself. In all cases, the underpinning material must enable students to understand and achieve all of the chemical engineering outcomes. (Section 3.6, Appendix A1/B1)*

*3. **Credit totals**: Note that the required minimum totals for Level B topics and for Advanced Chemical Engineering are in each case significantly greater than the sum of the component elements.*

*4. **Embedded learning**: – It is expected that modules throughout a programme include, illustrate and reinforce aspects of sustainability, SH&E and, where possible ethics, along with General Transferable Skills, as set out in Appendices A5 and B5. It is expected that a wide variety of delivery methods is used throughout so that students acquire the range of interpersonal and management skills etc to equip them to the modern engineering workplace. No credits should be allocated to the embedded learning section.*

*5. **Complementary topics**: Complementary topics must not be included in the credit assessment. (Section 3.9)*

*6. **Multiple programmes and options**: Where a choice is available to students, the "worst" case should be evaluated. (Section 4.1.3)*

4.2 Distinguishing features of accredited programmes

4.2.1 Distinguishing features of M-Standard programmes

Programmes accredited at M-Standard integrate the features of first and second cycle degrees (e.g. some Irish, New Zealand and Australian BE degrees and UK Integrated Masters degrees). M-Standard programmes go beyond B-Standard to provide a greater range and depth of specialist knowledge, within a research and industrial environment, as well as a broader and more general academic base. Graduates will therefore have an ability to apply their knowledge and skills to solving, from first principles, complex problems not typically encountered in a B-Standard programme. Such programmes should provide both a foundation for leadership and a wider appreciation of the economic, legal, social, ethical and environmental context of engineering.

Graduates from an M-Standard programme must achieve a systematic understanding of the learning outcomes in Appendix A, including the outcomes at Level B and the advanced outcomes at Level F (see Appendix C). They must acquire a coherent and detailed knowledge of the subject, most of which is at, or informed by, the forefront of defined aspects of chemical engineering. Crucially, graduates will have the ability to integrate their knowledge and understanding of mathematics; science; computer-based methods; design; the economic, legal, social, ethical and environmental context; and engineering practice to solve a substantial range of chemical engineering problems, some of them complex or novel. They will have acquired much of this ability through involvement in individual and group design work. Ideally some of this work would have industrial involvement or be practice-based.

The Level F advanced outcomes will be achieved through a combination of 'Depth' and 'Breadth', as set out in Appendix A6. They will also have achieved advanced outcomes in chemical engineering practice and in design (Appendix A3.3 and A4.3). In addition, there may be study of **complementary subjects** – including other science/technology, or other non-chemical engineering subjects such as business or languages.

IChemE expects M-Standard degree programmes to have strong involvement and interaction with industry and to provide greater industry-relevant exposure of students than B-Standard programmes.

Ideally, features which distinguish the Level F part of the programme will be integrated throughout the latter years of the programme. Where appropriate, student progression to Level F should be conditional on a demonstration of good academic performance. There should be appropriate and clear criteria to ensure this.

These programmes should also include a substantial open-ended activity which stretches and develops students' problem solving and creative thinking capacities. Examples include:

- *Research linked to the department's own postgraduate research programmes, or research undertaken at an industrial research laboratory/institute (this could be conducted as an interdisciplinary project).*
- *Analysis of an industrial process, perhaps combining a period in industry with some analytical or theoretical work at the university.*
- *A theoretical project including a literature review with subsequent data analysis/computer modelling.*

4.2.2 Distinguishing features of B-Standard programmes

B-Standard degree programmes are also referred to as first cycle degrees (e.g. some Irish and Australian BE degrees and UK Bachelors (Hons) degrees). B-Standard programmes develop the ability to apply a thorough understanding of relevant science and mathematics to the analysis of chemical engineering problems and the design of technical solutions.

Graduates from B-Standard programmes must achieve a systematic understanding of the learning outcomes specified in Appendix A1-A5 (excluding the advanced material in A3.3 and A4.3) at IChemE Level B, including acquisition of coherent and detailed knowledge, much of which is at, or informed by, the forefront of defined aspects of chemical engineering. Crucially, they will have the ability to integrate their knowledge and understanding of mathematics; science; computer-based methods; design; the economic, legal, social, ethical and environmental context; and engineering practice to solve problems, some of a complex nature, in chemical engineering. They must have completed a satisfactory design portfolio, supported by individual and group project work. In addition, there may be study of complementary subjects – including other science/technology, or other non-chemical engineering subjects such as business or languages.

IChemE makes no specification regarding advanced chemical engineering content of these programmes and leaves provision and inclusion of any such advanced content entirely at the discretion of the programme designers.

4.2.3 Distinguishing features of F-Standard programmes (typically MSc)

F-Standard programmes (2nd cycle degrees, typically MSc) in chemical engineering either provide a deeper understanding of general chemical engineering or focus on a specific branch of the subject such as nuclear engineering or biochemical engineering. To be accredited as F-Standard, the programme must clearly demonstrate delivery of Level F advanced learning outcomes in Appendix A, beyond the attainments in a B-Standard chemical engineering degree.

The Level F advanced outcomes will be achieved through a combination of 'Depth' and 'Breadth', as set out in Appendix A6. They will also have achieved advanced outcomes in chemical engineering practice and in design (Appendix A3.3 and A4.3). In addition, there may be study of complementary subjects – including other science/technology, or other non-chemical engineering subjects such as business or languages.

4.2.4 Distinguishing features of D-Standard programmes

D-Standard programmes (e.g. Singapore Diploma and UK HND) have an emphasis on development and attainment of the know-how necessary to apply technology to chemical engineering problems and processes, and to maintain and manage current technology, sometimes within a multidisciplinary engineering environment.

Graduates from D-Standard programmes must achieve the learning outcomes at IChemE Level D, as described in Appendix B. The breadth and depth of underpinning scientific and mathematical knowledge, understanding and skills will be provided in the most appropriate manner to enable the application of engineering principles within existing technology to future engineering problems and processes. Graduates are likely to have acquired some of this ability through involvement in individual and/or group design projects.

Programmes will develop a knowledge and understanding of current engineering practice and processes, with less focus on analysis than in B-Standard programmes, for example:

- greater exposure (where time allows) to 'related technologies' such as management and business issues, IT and its application
- greater emphasis on aspects of plant operation, maintenance, reliability and process viability, capability and optimisation

Design will be a significant component, especially in integrating a range of knowledge and understanding to design products, systems and processes to meet defined needs using current technology. An example might be practical development of a major project which places emphasis on 'practical process improvement', ideally in conjunction with a local employer.

4.3 Taught delivery methods and departmental practice for student assessment

4.3.1 Delivery methods

Various methods can be used to deliver a programme satisfying the learning outcomes, depending on the style of teaching appropriate to the university and the students, the number of students taught and the varied nature of content. IChemE encourages the use of diverse methods and innovation in teaching.

The choice of methods is at the discretion of the university. The methods used could include lectures; tutorials; laboratory and workshop sessions; problem-centred learning; distance learning; and computer-aided learning. In addition, programmes may incorporate industrial placements, or study at other universities at home or abroad.

Whilst much of the teaching will be done by university staff, the use of external lecturers and supervisors is encouraged, where these can supply knowledge and experience not otherwise readily available. Examples might be in the supervision of design work, the presentation of case studies, or in the lecturing of special topics.

4.3.2 Assessment

The purpose of assessment by a university is to confirm that individual students have attained the necessary learning outcomes, and that this attainment is at the appropriate level for the degree being awarded. How individual modules are assessed is for the university to decide but, within a programme, a variety of assessment forms is expected and may include on-line quizzes and other innovative forms. For some parts of the programme, there should be an assessment of a student's oral presentation.

It is expected that the university will have its own formal procedures for assessment and maintain a robust quality assurance process to ensure that outcome standards are consistent and fair. The procedures should include safeguards against academic dishonesty (e.g. plagiarism and other forms of cheating).

4.4 Evidence of achievement of learning outcomes

IChemE will look for evidence that students have attained the learning outcomes in each of the areas outlined in Section 3.

Typical examples of direct evidence include:

- examination papers, together with model answers and marked scripts
- project reports
- laboratory reports
- design project reports
- industrial placement reports

Typical examples of indirect evidence include:

- external examiner's reports
- internal and external audits
- quality assurance reports external to the department

4.5 Learning periods away from the home university

Many programmes contain an assessed period of learning away from the home university – either in industry or at another university.

In cases where the assessed period away from the home university contributes to the overall degree award, and hence to the learning outcomes relevant to accreditation, IChemE will look for strong, clear evidence of:

- defined learning outcomes for the period away
- suitability of the placement organisation
- rigorous standards of supervision
- rigorous assessment of the outcomes achieved by the student; and
- quality assurance of the overall system of student placements.

Where the assessed period away is spent in an industrial environment, examples of evidence might include:

- project work or dissertations
- presentations and posters
- academic programmes/modules undertaken during the period away (distance learning)
- continuing professional development programmes.

Where the assessed period away is spent at another university examples of evidence might include:

- programme of studies completed when at the partner university
- examples of assessed project work and/or examination papers.

In each case it is expected that the students would re-enter the degree programme at a more advanced stage than when the period away began.

4.6 Compensation strategy

It must not be possible for any student to graduate without having successfully completed (in each of the IChemE learning outcomes categories) the minimum credits stipulated as the threshold for the level of accreditation awarded.

In some assessment schemes it is possible for students to compensate for poor performance in one module by achieving better marks in other modules. For example, a student scoring just below the pass mark in a particular module might be excused the failure if their average performance for all modules in the same semester or year was above a particular level, such as >10% above the normal pass mark. Because practices vary from university to university, it is necessary to detail such compensation strategies at the appropriate point within the questionnaire submission. The department must supply evidence that the learning outcomes have been met elsewhere in the programme by students compensated in this way. Programmes allowing compensation may only be accredited if there is a maximum 10 IChemE credit compensation in the final year.

4.7 Resources, including professional membership

It is expected that appropriate human and physical resources will be in place to support the delivery of the programme.

A department running an accredited degree must employ a sufficient number of full-time academic staff, including professionally qualified chemical engineers, for students to have reasonable access to them for instruction and guidance.

IChemE holds the view that academic staff have a hugely important role in exemplifying professional behaviours to students. It therefore expects that a significant proportion of senior faculty (e.g. professors, associate professors, senior lecturers) hold professional level registration, or are engaged in the application process, with a recognised professional body for chemical engineering or, where appropriate, cognate discipline.

The IChemE degree programme questionnaire seeks details of staff resources and laboratory, information and learning facilities. These will include the full-time equivalent (FTE) staff involved in the teaching programme and information on typical sizes of laboratory and design groups. An opportunity to meet staff and to view the facilities is included in the timetable for all accreditation visits.

4.8 Safety, health & environment culture and practice

In addition to formally taught process safety (Appendices A2.6 and B2.6), IChemE insists that students on accredited degree programmes must be instilled with appropriate attitudes to safety, health & the environment (SH&E). The demonstration or otherwise of an adequate safety culture within a department will form part of the IChemE assessment.

Evidence of an effective Safety, Health and Environment (SH&E) culture includes:

- Leadership – Head of Department and Senior Management take an active part in SH&E.
- Visibility – clear and relevant signage and information; good standards of housekeeping in laboratories.
- Behaviour – staff, students and visitors behave in a careful, risk-averse manner; Personal Protective Equipment is available and usage is enforced; there are systems for incident reporting, follow-up, feedback and improvement.
- Legislative Compliance – there is a sound understanding of, and compliance with, applicable SH&E legislation.
- Risk Assessment and Management – Risk Assessment and Permit to Work systems are in place; those who use them are fully conversant with their roles and responsibilities.

For further information on safety culture, refer to Page i for the link to Application documents

4.9 Ethics culture

IChemE recognises that modern chemical engineering degrees need to include ethics as an integral component of the curriculum. Codes of conduct, an important part of engineering ethics, are the framework for professional behaviour. IChemE, like other professional engineering institutions, has a code of conduct specific to the chemical engineering profession which its members are required to follow; comparable codes exist in other countries (e.g. Australia and Ireland), though these are usually more general to the engineering profession as a whole. IChemE recognises that different codes of conduct have many common features and expects all accredited programmes to develop a strong ethos of professional behaviour and its implications.

Ethics learning outcomes should be related to the four basic principles outlined by the Engineering Council and the Royal Academy of Engineering*:

- Accuracy and rigour (e.g., act with competence presenting and reviewing engineering competence; identify and evaluate possible risks)
- Honesty and integrity (e.g., be aware of how own behaviour can affect others; prevent corrupt practices and professional misconduct; declare conflict of interest)
- Respect for life, law and public good (e.g., take account of limited availability of human and natural resources; hold paramount the health and safety of others)
- Responsible leadership (e.g., be aware of the issues that engineering raises for society; promote the public awareness of engineering benefits and impact)

Awareness of engineering ethics guides students in preparation for their professional lives and helps them to identify ethical issues and the practice in which they arise. Ethics also helps students to develop wider skills in communication, reasoning and reflection, and the professional attitude to carry forward into their working life.

* Engineering Council and Royal Academy of Engineering, "Statement of Ethical Principles", http://www.raeng.org.uk/publications/other/statement-of-ethical-principles

5. Overview of the accreditation process

5.1 Accreditation ethos

IChemE's accreditation process is a cooperative activity intended to be of benefit to both the department and IChemE. Besides the accreditation assessment by IChemE, departments benefit from an intensive professional consultation on their programmes and gain access to an international chemical engineering teaching community with opportunities for sharing good practice and progressing challenging issues. IChemE accreditation is a joint enterprise in which both parties seek the truth through mutually respectful discussion of the available evidence.

5.1.1 Confidentiality and document ownership

The accreditation process is confidential between IChemE and the university department. IChemE will retain ownership of all reports produced but will make these available to departments in confidence and where appropriate.

5.2 Principal stages of accreditation

The IChemE accreditation process has the following principal stages:

- Initial contact between the university department and IChemE
- Preparation by the department and submission to IChemE
- Appointment of assessors by IChemE
- Preparation and visit by the panel of assessors
- Report by the assessors to IChemE
- Decision by IChemE's Education and Accreditation Forum
- Implementation of follow-up actions by the department

A timeline for the process is given in Table 6, with further details in the Sections which follow.

Table 6: Indicative timeline for accreditation

Time from visit		University department	IChemE assessors
Months	By -36	New programmes etc – initial contact with IChemE*	(Re-)training
	By -24	New/revised programmes – design and implementation	
	-24 to -3	Collect supporting documents Contacted by IChemE re visit dates	Contacted by IChemE re visit dates
	-3	Submit IChemE questionnaire and supporting documents	Receive questionnaire and supporting documents
	-3 to 0	Prepare for visit	Study pre-visit documents Pre-visit clarifications with department
The visit (2 days)			
Weeks	+3		Prepare and agree report
	+8	Comment on draft report	Lead assessor presents report for EAF decision.
	By +12		IChemE informs department of outcome
	+12 onwards	Follow-up if required (meet conditions etc)	If required, review follow-up report etc

* *IChemE contact details are given at the end of this document.*

5.3 Multiple campuses

In accordance with IChemE's Engineering Council Licence*, when a university offers multiple versions of a programme in different locations, IChemE must visit each location for which programme accreditation is sought, even where the programme is identical. An annual accreditation subscription will be applied, as in 5.9 below, for each campus visited.

Universities with multiple campuses should contact IChemE in good time to discuss the arrangements for the accreditation process. As a guiding principle, the procedures set out in this document apply individually and separately to each campus concerned.

5.4 Initial contact – new programmes

IChemE will work with departments new to IChemE accreditation, to explore the best approach to accredited status. Where appropriate, this could include a preliminary 'benchmarking' assessment and/or the appointment of a mentor to help the department develop to meet the accreditation requirements.

All departments planning to introduce new programmes for accreditation are recommended to contact IChemE at an early stage.

For further information, refer to the Supporting documents found at: http://www.icheme.org/accreditation/university-accreditation/supporting.aspx

5.5 Initial contact – existing programmes

Where a programme is already accredited, IChemE will contact the department in the penultimate year of accreditation with a view to arranging a visit during the last accredited year, in order to maintain continuity of accreditation. Where a department has several accredited programmes, IChemE will do its best to align the periods of accreditation.

In exceptional circumstances (e.g. a major disruptive event), a department can apply in writing to extend the accreditation for a short period.

5.6 Preparation by the department

The department will need to make available documents of various kinds for review by the assessors. Since this includes work done by students, preparation of these documents needs to be considered a long time (up to three years) ahead of the visit. Closer to the visit, the department will be asked to submit a completed questionnaire and other relevant documents to IChemE.

Further details are given in Section 6.

5.7 IChemE assessors and the visit

IChemE maintains a pool of trained assessors. A panel of three assessors comprising at least one academic and at least one industrial person will be selected from the pool. Where feasible, the panel will include members from outside the country of the department visited and with an understanding of the local education system. One of the panel will be appointed as Lead Assessor. Occasionally, an observer may accompany the panel – often a potential addition to the pool or a member of IChemE staff.

Where appropriate, it may be possible to combine the IChemE visit to coincide with another accrediting body. Further details of joint accreditations are given in Section 9.

The assessor panel will receive the documents provided by the department to help them prepare the visit. The visit to the department will normally occupy two working days and, during the visit, assessors will wish to meet staff, representative students, recent graduates and, where feasible, industrial partners such as employers and advisory panel members.

Following the visit, the assessors will report their findings to IChemE. The report, excluding the recommendations of the assessors, will be sent to the department for comment on any factual inaccuracies.

Further information on the appointment and role of the assessors is given in Section 7.

5.8 The accreditation decision and subsequent actions

The completed accreditation report will be considered by IChemE's Education and Accreditation Forum (EAF) and a decision on whether to accredit will be made. The EAF will usually work through Virtual Accreditation Panels (VAPs) which usually meet monthly for this purpose. The department will be notified of the outcome at the earliest opportunity.

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* Engineering Council *Registration Code of Practice*, (2014) para 27, available from http://www.engc.org.uk

Following a successful accreditation, the department will receive a certificate of accreditation. Any conditions set by EAF must be met by the given date.

Further information on the decision and follow-up are given in Section 8.

5.9 Accreditation costs and cost sharing

The costs of accreditation include the cost of administration and some of the direct costs of travel and subsistence for the accreditation assessors. IChemE seeks to share the direct costs with the universities undergoing assessment.

The international standard of IChemE accreditation is maintained through our use of a global pool of trained assessors. All assessors are volunteer members of IChemE, working on a *pro bono* basis, so no fees are payable. All assessment visits aim to include at least one assessor from outside of the region. Hence, the travel and subsistence costs incurred by the assessors undertaking a visit vary substantially, depending on both the geographic region and where the assessors are travelling from.

In order to provide a fair system of recovery of some direct costs of accreditation, IChemE introduced a fixed subscription for university accreditation from January 2014. The annual subscription is payable by each department that has accreditation and will cover all programmes accredited in one accreditation visit. There will be no additional charge for the assessors' travel and accommodation as this will all be covered by the annual accreditation subscription.

In order to meet full accreditation for programmes which are delivered at more than one campus all campuses are required to have a separate accreditation visit. A separate annual accreditation subscription will be invoiced to each campus visited.

For departments without accredited programmes or for new programmes, direct charges will, at the discretion of IChemE, be made for benchmarking or other assessments.

For further information, refer to the Supporting documents found at: http://www.icheme.org/accreditation/university-accreditation/supporting.aspx

6. Preparation for accreditation

6.1 Preparing the submission documentation

Once contact has been established between IChemE and the department regarding possible accreditation, the department should in good time appoint a member of staff to be responsible for the whole process including the timely and comprehensive submission of documentation ahead of the visit. Early on, a provisional visit period will be agreed, and the visit date itself will be finalised somewhat later in the process, as set out in Section 7.1.

In good time before a visit is to take place, the department should ensure that the necessary evidential documents are available. Since these will include examples of work completed by students (such as examination scripts and design projects), some of this preparation needs to be made in previous academic years. Examples of a range of performance (high, middle, threshold pass) need to be provided, together with a clear indication of the marking of such pieces of work. As an example (and where this is not already the practice), departments should consider requiring students to submit digital copies of major project reports, in order that these can be made available to accreditation assessors before the visit.

Document preparation needs to be rigorous and it is advised that sufficient time is made available for this activity. IChemE requires that document submissions are sent in digital form. Various digital forms are acceptable, provided that they are well-structured, easily navigable, readily usable and can be accessed on commonly-used digital platforms. Forms which have been found to work well include DropBox, dedicated university web- or VLE site and portable memory stick. **Whatever form is chosen, it must be convenient for assessors to download or transfer material so that they have access offline (e.g. whilst travelling).**

The submission comprises a completed degree programme questionnaire and supporting documentation, as detailed in Table 7. The complete set of documents should be sent to IChemE three months before the visit.

IChemE will copy or otherwise make available the documents to the assessor panel. After the assessors have received the advance documents, and prior to the visit, they may identify a need for further information. In such cases IChemE will give the department as much notice as possible to provide this or, alternatively, make arrangements for this to be available for review during the assessors' visit.

Table 7: Documentation required from Department three months before the visit

Category	Items required/description	Notes
Degree or diploma programme questionnaire	The degree or diploma programme questionnaire is a critical document and provides a structure for the department to collate all essential descriptive information on the degree programme(s) comprehensively for advance assessment by IChemE	Refer to IChemE's separately available Application Documents for the degree and diploma questionnaires
Curriculum details	Programme structure – e.g. list of modules, showing year of delivery, credit value, options etc	Where available, the programme handbook supplied to students may supply these details in a convenient form.
	Descriptors of all modules, showing learning outcomes, teaching methods (e.g. lectures, practicals, projects), methods of assessment, etc	
	Briefs for major research/design projects including scope, assessment criteria (individual/group) and marking schedules	
Staff details	Brief CVs of academic staff including professional associations	
Evidence of the learning outcomes actually achieved by students.	Complete sets of examination question papers with marking schemes (past 2 years)	Evidence should be a representative cross-section (high, middle, threshold pass) and drawn from all parts of the degree programme. Evidence must include, in all cases, markers' comments and marks.
	Major design project reports (three examples each)	
	Research and/or other (as appropriate) Level F project reports (three examples each)	
	(Optional, as appropriate) External assessment	
	(Optional, as appropriate) Industrial project reports	

Important note: in preparing the above documents, the department must ensure that it is clear to IChemE which programmes are being assessed and, where there are several programmes, indicate details of multiple/parallel content.

6.2 Preparing the department for the visit

It is good practice for senior university staff to be briefed ahead of the visit. Likewise, department staff, representative recent graduates and students should also be briefed adequately to include the purpose, aims and possible outcomes from the IChemE assessment.

During the visit, key staff are expected to be readily available to meet the assessors. This includes programme leaders, advisors, laboratory managers, safety managers and others (e.g. senior management, library, QA or ICT staff) as deemed appropriate by the department.

6.3 Supporting the assessors' visit

The department should expect to provide additional supporting documentation for the assessors to examine in support of their assessment. Such material should be made available during the visit and must include:

- additional student materials to demonstrate learning outcomes achieved, such as marked examination scripts, laboratory reports, project reports; and
- evidence of academic quality assurance – e.g. external audit, academic review reports, External Examiner reports.

Further information might also include:

- management structure;
- industry involvement; and
- how sustainable development, ethics, safety etc are embedded in the programme.

A serviced meeting room should be prepared and made available to the assessors for their private reviews and deliberations. This room must have Wi-Fi for the assessors and contain all supporting documentation provided to the assessors for their perusal.

7. IChemE assessors and the visit

7.1 Visit planning

Accreditation visits will include both a pre-meeting of the assessors on the evening before the visit and normally two full days at the university (see Appendix D), though visits to universities seeking first accreditation may possibly take longer.

Forward planning of the IChemE visit calendar is important in order to ensure that assessors and resources are available. At least eighteen months before the visit is due, IChemE staff will negotiate with the department a target three-month period during which the visit will take place. Nearer the time, where possible at least one year ahead, IChemE will liaise with the department to agree the month of the visit. Following this, the assessor panel will be identified. At least six to nine months before the visit, IChemE staff will liaise with the department to finalise a mutually convenient date for the visit during term-time, with due regard to academic calendars and assessor availability. At this point they will also agree the structure of the visit, and initiate logistical arrangements such as timings, accommodation, travel etc.

This process allows the department time to prepare a comprehensive submission and to plan its own arrangements (Section 6). The preliminary documentation (Section 6.1) must be made available to IChemE at least three months before the visit date.

IChemE staff will distribute the documentation supplied by the department to the assessors for review in advance of the visit and will liaise regarding any further materials or arrangements required prior to the visit.

Refer to Appendix D for a typical visit schedule

7.2 Selection of assessors

IChemE maintains a pool of trained assessors who are all Chartered Chemical Engineers. The pool comprises both academics and industrialists who have current knowledge of the accreditation process and requirements. Assessors are appointed to the pool by nomination to and decision of the Education and Accreditation Forum (EAF).

Assessment panels, each comprising three assessors including the lead assessor, are approved by processes set by EAF using the following criteria:

- all assessors will have received IChemE training
- no more than one assessor should be without previous visit experience
- panels will include assessors from our worldwide assessor pool with, where possible, one from outside the country of the university and one with understanding of the local education system
- panels will always comprise at least one academic and at least one industrialist
- panels will, if possible, include members with specialist expertise appropriate to the programmes being considered (e.g. biochemical engineering).

For re-accreditation visits, IChemE will, if appropriate and possible, strive to ensure that one assessor should have been a member of the panel for the previous visit.

Departments do not have the right to select or approve the membership of the assessor panel. Should there be exceptional circumstances that concern the department (for example a perceived conflict of interest with an assessor) then these concerns should be communicated in writing at the earliest possible opportunity to the senior IChemE staff responsible for accreditation and the Chair of Education and Accreditation Forum (EAF).

7.3 The role of IChemE's assessors

Assessors act in a voluntary capacity on behalf of IChemE. They are required to work within IChemE's code of conduct for volunteer members on IChemE activities (see IChemE Supporting Documents).

The assessors' primary role is to seek evidence to verify that the target learning outcomes are being achieved by assessing the scope and depth of the examinations, projects, laboratory work and other learning activities completed by the students. The accreditation visit allows for time to view the resources that support this learning.

The general questions that underpin the work of the assessors include:

- are the entry qualification profiles of students satisfactory?
- are the learning outcomes clearly defined and are they appropriate?
- is the programme structure and content appropriate to deliver the learning outcomes?
- are the resources to support the delivery of the learning outcomes adequate?
- are the learning outcomes achieved to an appropriate level?

Assessors frequently request to see additional materials during their visit. Departments are respectfully requested to be prepared for, and accommodating of, reasonable requests.

At the end of the visit, assessors will give feedback on their principal findings, including recommendations for improvement. They are, however, instructed not to tell the department their recommendation on the accreditation outcome. The decision will be taken at the EAF meeting at which the assessors' report (see 7.4) is discussed and moderated. While assessors are required to make recommendations to EAF about the decision, these may be overridden on examination by EAF to maintain consistency with IChemE criteria and with other accreditation decisions.

7.4 The assessors' report

The assessors prepare a written report to IChemE's Education and Accreditation Forum. The report is expected to be submitted to IChemE within three weeks of the visit.

7.4.1 Purpose of the report

The primary purpose of the assessors' report is to inform EAF of their findings and how learning outcomes have been met. The assessors' report includes a summary of general aspects of the visit, such as resources, safety culture and discussions with staff and students, which impact upon the delivery of those learning outcomes.

In addition, the assessors will:

- identify and commend strengths and good features within the programme(s);
- identify areas where there may be scope to improve the programme(s);
- propose recommendations to the Education and Accreditation Forum (EAF) on the future accreditation status of the programme(s) reviewed.

7.4.2 Checking factual accuracy

IChemE will send the assessors' report, excluding the assessors' accreditation recommendation, to the department for comments on its factual accuracy prior to final decision by IChemE's EAF.

7.4.3 Confidentiality and ownership

At all stages, the assessors' report will remain confidential to and the property of IChemE. The report is made available in confidence to departments for their information.

8. Accreditation outcomes

8.1 Accreditation decision process

The Education and Accreditation Forum (EAF) exists to maintain standards and consistency of decision-making for IChemE accreditation. EAF usually meets four times per year and is comprised of experienced IChemE assessors who are collectively responsible for all decisions on accreditation. Potential conflicts of interest are declared at the start of each EAF meeting and those concerned are normally required to leave the meeting during the relevant discussion.

EAF will formally review the assessors' report, together with the accreditation recommendation of the assessor panel for final decision. EAF appoints from its membership a rapporteur for each accreditation visit. The rapporteur will raise (e.g. by email) and resolve as many issues as possible concerning the report with the lead assessor prior to the EAF meeting, so that these can be noted with minimal need for further discussion. EAF meetings include video/audio links, so that an accreditation panel member (where possible the lead assessor) always be in attendance, in person or virtually, to contribute to the decision-making process. At the EAF meeting, the visit report is introduced by the lead assessor (or other panel member) and the rapporteur clarifies and highlights their findings. EAF resolves any outstanding issues by discussion with the assessor and decides the outcome, usually by consensus.

EAF may ask the lead assessor to amend the report to clarify any ambiguities or other misleading statements. The report will be sent to the department for comment on any factual inaccuracies. Any significant changes arising from this and accepted by the assessors will be brought to the attention of EAF. Where such changes may have a material effect on the outcome, further discussion will take place as above.

EAF will usually appoint a Virtual Accreditation Panel, comprising at least five of the EAF membership, to decide accreditation outcomes. VAPs meet monthly and operate in the same way as described above but with the additional step of ratification of the VAP decision by correspondence or otherwise full discussion of the decision at an EAF meeting.

Decisions of the EAF are normally communicated to the department within two weeks of the EAF discussion. Occasionally, further information or clarification may need to be sought before a final accreditation decision is made (normally at the subsequent meeting).

8.2 Accreditation outcomes

Decisions are based foremost on maintaining benchmark standards of academic formation. IChemE will seek to help departments, providing advice and counsel to support continuous improvement of their programmes. IChemE also seeks to commend and encourage the sharing of educational good practice amongst the community of accredited departments worldwide.

8.2.1 Available decisions

Education and Accreditation Forum (EAF) will make one of the following possible decisions:

- **Accredit/re-accredit the programme(s) without condition**
- **Accredit/re-accredit the programme(s) subject to conditions**

  Such accreditations will be dependent upon the department meeting requirements set by IChemE following its review of the assessors' report. See 8.2.2.

- **To not accredit/re-accredit the programme(s)**

  In this instance IChemE will advise why the programme has failed to be accredited and will, upon request and where appropriate, advise the department on available assistance.

Refer to Appendix E for an indication of how accreditation decisions are reached.

8.2.2 Conditions

IChemE may make accreditations subject to conditions. These are binding on the department and must be resolved within the indicated timeframe for accreditation to be maintained and valid.

Any conditions will be programme specific. Examples have included further report submissions, changes to programme modules, demonstration of stronger safety culture etc.

Fulfilling the conditions is the responsibility of the department. Reports on fulfilment must be made formally in writing for EAF consideration and accreditation decision.

Reports on condition fulfilment may be sent to the original assessors for comment to advise EAF. In some cases, a visit by an assessor may be required to confirm the action taken by the department.

8.2.3 Period of accreditation

Accreditation may be granted for a period up to a maximum of five years. New accreditations will not normally exceed three years.

Accreditation is effective from the date of entry of the first student cohort following the academic year that IChemE visits. It is normally not possible for an accreditation award to be retrospective. However, accreditation may be back-dated to allow cohorts already on the programme at the time it is accredited to benefit from the decision, provided that the work of that cohort of students has been reviewed as part of the accreditation exercise.

The period of accreditation may be reduced by the amount for any extension (see 5.5) granted to the previous accreditation.

Where conditions are made, the accreditation certificate will be to the end of the period set for them to be resolved. This is to allow the certificate to be displayed publicly without showing any conditions. Once the conditions have been met, a new certificate will be issued to reflect the full period of accreditation.

8.2.4 Recommendations to the department

In the majority of cases IChemE seeks to make recommendations to the department. These are not mandatory. However, they are offered in the spirit of providing help and sharing of good practice in chemical engineering education. Adoption by the department of these recommendations is encouraged and generally expected.

8.3 After the accreditation decision

Following an accreditation award, the department will be sent a decision letter and, separately, a certificate to formally acknowledge the accredited status of the programme(s).

There will be ongoing contact between IChemE and the department in terms of accreditation policy developments during the period of accreditation. IChemE's qualifications department will liaise with the university department regarding policy changes, student services, membership and related activities.

8.4 Obligations and duties on departments

It is a general condition of accreditation that departments must inform IChemE in a timely fashion of significant changes to the curriculum or resources that impact upon the delivery or nature of the accredited programme. Changes which must be notified include:

- changed learning outcomes;
- changed programme title;
- changed programme structure;
- loss of key staff which could affect the integrity of the programme;
- adverse impacts on resources, such as due to an upsurge in student numbers or the loss of staff or facilities.

Departments often need to make changes to a programme during the period of accreditation and IChemE understands the need for this. Where the change is substantial, an interim accreditation visit may be required.

All departments with accredited programmes are encouraged to contribute to the development and implementation of accreditation policy and to share good practice in chemical engineering education. For example, IChemE seeks to identify senior and experienced academic staff from as wide a range of departments as possible, on an international basis, to join the pool of accreditation assessors. In addition, it is considered to be normal practice that the department, with the help of IChemE, encourages uptake of student membership of IChemE amongst the cohort. Further, the IChemE Education Special Interest Group (EdSIG) exists to share good practice and debate current issues in chemical engineering education. All chemical engineering departments are strongly encouraged to engage with EdSIG's numerous events and activities.

8.5 Endorsement logos

Our endorsement logos enable external universities and other organisations to demonstrate IChemE approval. They are to be used only for the category accredited and must be used in compliance with IChemE guidance provided with the logo. These logos will appear as an endorsement and can be used alongside the logo of the university on print and web material.

8.5 Appeals procedure

IChemE maintains an appeals procedure for universities who wish to appeal against irregularities in the process of accreditation.

Appeals against accreditation decisions will be considered by a panel appointed by the IChemE Qualifications Committee.

For further information, refer to the Supporting documents found at: http://www.icheme.org/accreditation/university-accreditation/supporting.aspx

9. Working with other accrediting bodies

9.1 Introduction

IChemE will normally agree to conduct an accreditation or benchmarking study by invitation of a university. Such invitations usually arise because of recognition of the distinct value of discipline-specific, in-depth peer review of chemical engineering teaching that IChemE provides.

IChemE completely respects the need for national-level accreditation systems and welcomes the fact that agreements, such as the International Engineering Alliance's Washington Accord, provide confidence in the quality of university accreditation processes.

It is possible to combine an IChemE accreditation visit to coincide with another accrediting body. IChemE has experience of visits to complement those of other national accrediting bodies either through joint visits or visits closely following the schedules of the national body. Examples include coordination with Engineers Australia, UK Engineering Accreditation Board and Institution of Professional Engineers New Zealand.

For further specific information on what is required from the university for a joint accreditation visit, please contact accreditation@icheme.org

9.2 Operational arrangements

Joint accreditation is at the discretion of IChemE. It is essential that any department contemplating joint visits should discuss the options with IChemE at the earliest possible opportunity to allow ample time for coordination between the organisations concerned.

IChemE staff and the IChemE Lead assessor will liaise with representatives of the partner organisation(s) to optimise the arrangements, especially requirements for and use of documentation. The two organisations will similarly liaise over the visit schedule to ensure that each is able to satisfy its requirements, whilst minimising the need for separate meetings and events.

9.3 Decision-making for joint accreditations

IChemE reserves the right to decide accreditation outcomes independently against the standards set out in these guidelines. However, for joint accreditations, the Lead Assessor will liaise with their counterpart(s) in the partner organisation(s) to align as far as possible the judgements made. Inevitably, there will be occasions where opinions cannot be aligned and details of these will be brought to the attention of EAF through the assessors' report.

10. Further information about application

10.1 Applying for accreditation

Departments seeking new accreditation(s) can request this from IChemE at any time. IChemE will provide help and guidance at any stage and, in particular, encourages departments to seek informal advice and guidance at an early stage.

Departments that currently have accredited programmes will automatically receive a reminder from IChemE well before the expiry date of the existing accreditation period, inviting the department to submit their programme(s) for re-accreditation.

Further information can be found in the Supporting documents at: http://www.icheme.org/accreditation/university-accreditation/supporting.aspx

List of appendices

Appendix A

Learning outcomes at Levels B and F

A1 Underpinning mathematics, science (chemistry, physics, biology) and associated engineering disciplines

A1.1 Introduction

Students' knowledge and understanding of mathematics, science and associated engineering disciplines should be of appropriate depth and breadth to underpin their chemical engineering education, to enable appreciation of its scientific and engineering context, and to support their understanding of future developments. It is expected that this underpinning material should be taught in an engineering context and, where appropriate, a chemical engineering context.

The amount of underpinning mathematics and science will vary between programmes, particularly reflecting variations in entry qualifications and/or structure of the earlier year(s) of the programmes. Departments will need to provide evidence that students have achieved the levels in these topics to underpin all the other required Learning Outcomes in chemical engineering.

A1.2 Learning outcomes – Level B

Students graduating from an accredited programme will:

- Have a knowledge and understanding of mathematics necessary for the analysis of and to support applications of key chemical engineering principles and processes.
- Have a knowledge and understanding of basic mathematical models relevant to chemical engineering.
- Have a knowledge and understanding of scientific principles, namely the relevant aspects of physics, chemistry, biochemistry, biology and materials science, to enable the understanding of chemical engineering principles.
- Have a basic understanding of relevant elements from engineering disciplines commonly associated with chemical engineering, such as electrical power and motors; microelectronics; mechanics of pressure vessels; structural mechanics.

A2. Core Chemical Engineering

A2.1 Introduction

Core chemical engineering comprises the main principles and applications of chemical engineering. Students graduating from an accredited programme will:

- Understand the principles of fluids and solids formation and processing.
- Be proficient in applying these principles to problems involving fluid flow, heat transfer, mass transfer and reaction engineering.
- Be able to apply the principles to the analysis of complex systems within a structured approach to safety, health and sustainability.

It is desirable that throughout the programme the students should gain an understanding of the broad range of applications of the principles and develop the ability to analyse, model quantitatively and synthesise at the appropriate scale. The applications should include:

- Different types of process, including continuous and batch; chemical processes and bioprocesses.
- Different time scales: short and long periods; steady and unsteady state.
- Different physical scales: from molecular level to large scale continuous.

Students must acquire the knowledge and ability to handle broader implications of work as a chemical engineer. These include sustainability aspects; process safety, health, environmental and other professional issues including ethics, risk, commercial and economic considerations etc.

Important: The outcomes in this Section A2 are expressed for outcome Level B. Please see Section A6 for how these are interpreted for Level F.

A2.2 Fundamentals – Level B

Students graduating from an accredited programme will:

- Understand the principles of material and energy balances.
- Understand the thermodynamic and transport properties of fluids, solids and multiphase systems.
- Understand the principles of momentum, heat and mass transfer, and be able to apply them to problems involving flowing fluids and multiple phases.
- Be able to apply thermodynamic analysis to processes with heat and work transfer.
- Understand the principles of equilibrium and chemical thermodynamics, and be able to apply them to phase behaviour, and to systems with chemical reaction.
- Understand the principles of chemical reaction and reactor engineering.

A2.3 Mathematical Modelling and Quantitative Methods – Level B

Students graduating from an accredited programme will:

- Be familiar with, and able to apply, a range of appropriate tools such as dimensional analysis and mathematical modelling.
- Understand the role of empirical correlation and other approximate methods.
- Be competent in the use of numerical and computer methods, including industry-standard chemical engineering software, for solving chemical engineering problems (detailed knowledge of computer coding is not required).

A2.4 Process and Product Technology – Level B

This is a broad heading that includes: the 'unit operations' of separation and mixing; particle technology; equipment sizing and performance.

Students graduating from an accredited programme will:

- Understand and be able to apply methods to analyse the characteristics and performance of a range of typical mixing, separation, and similar processing steps for fluids, particulates and multi-phases.
- Understand the principles on which processing equipment operates, and be able to apply methods to determine equipment size and performance of common items such as reactors, exchangers and columns.
- Understand and be able to estimate the effect of processing steps upon the state of the material being processed, and on the end product in terms of its composition, morphology and functionality.

A2.5 Systems – Level B

Students graduating from an accredited programme will:

- Understand the principles of batch and continuous operation and criteria for process selection.
- Understand the inter-dependence of elements of a complex system and be able to synthesise such systems by integrating process steps into a sequence and applying analysis techniques such as balances (mass, energy) and pinch.
- Understand system dynamics, be able to predict the response to changes in a dynamic system, and be able to design and determine the characteristics and performance of measurement and control functions.

A2.6 Process Safety – Level B

Students graduating from an accredited programme will:

- Understand the inherent nature of safety and loss prevention, and the principal hazard sources in chemical and related processes – including flammability, explosivity and toxicity (including biological hazards).
- Understand the principles of risk assessment and of safety management, and be able to apply techniques for the assessment and abatement of process and product hazards.
- Understand methods of identifying process hazards (e.g. HAZOP), and of assessing environmental impact.
- Be aware of specialist aspects of safety and environmental issues, such as noise, hazardous area classification, relief and blowdown, fault tree analysis,
- Have knowledge of the local legislative framework and how it is applied to the management of safety, health and environment in practice and in the workplace, from the perspectives of all involved, including operators, designers, contractors, researchers, visitors and the public.

A2.6.1 Safety Culture – Level B and Level F

In addition to the above 'taught' outcomes, it is expected that students' learning and teaching will be undertaken in an environment (Department, School, etc) where there is an obviously strong and effective safety culture and where the students will learn by example.

Thus, *students graduating from an accredited programme will understand that*: an effective Safety, Health and Environment (SH&E) culture includes:

- Leadership – Head of Department and Senior Management take an active part in SH&E.
- Visibility – clear and relevant signage and information; good standards of housekeeping in laboratories.
- Behaviour – staff, students and visitors behave in a careful, risk averse manner; Personal Protective Equipment is available and usage is enforced; there are systems for incident reporting, follow-up, feedback and improvement.
- Legislative Compliance – there is a sound understanding of, and compliance with, applicable SH&E legislation.
- Risk Assessment and Management – Risk Assessment and Permit to Work systems are in place; those who use them are fully conversant with their roles and responsibilities.

A2.7 Sustainability and Economics, Ethics – Level B

Students graduating from an accredited programme will:

- Understand the principles of sustainability (environmental, social and economic) and be able to apply techniques for analysing, throughout the lifecycle, the interaction of process, product and plant with the environment.
- Understand and be able to apply the main methods of minimizing the environmental impact on air, water, land, and integrated eco-systems, including waste minimization at source and 'end-of-pipe' methods.
- Be able to apply the principles of process, plant and project economics.
- Understand the need for high ethical and professional standards and understand how they are applied to issues facing engineers.

A2.7.1 Ethics Culture – Level B and Level F

Although 'taught' ethics is not excluded, it is not an essential requirement of an accredited degree. It is expected that the 'taught' outcomes in areas such as safety, sustainability and economics, together with the awareness of the code of conduct and professionalism, will lead to an embedded ethics culture.

Thus, *students graduating from an accredited programme will understand that*: an effective ethics culture includes:

- how sustainability, economics, health and safety and professionalism are informed by and influence the ethical reasoning and behaviour of the professional engineer.

A3. Chemical Engineering Practice

A3.1 Introduction

Chemical engineering practice is the practical application of chemical engineering skills, combining theory and experience, together with the use of other relevant knowledge and skills.

Graduates of accredited programmes must understand the ways in which chemical engineering knowledge can be applied in practice, such as in: operations and management; projects; providing services or consultancy; developing new technology.

Departments should demonstrate high standards of appreciation and practice of Safety, Health and Environment (SH&E) in their teaching and operations within laboratories, pilot plants and project work.

Typical learning outcomes include: possession of practical and laboratory skills relevant to chemical engineering; knowledge of the characteristics of particular equipment, processes or products; the ability to deal with technical uncertainty; appreciation of the sources and value of technical literature; awareness of the nature of intellectual property; facility in the use of appropriate codes of practice and industry standards.

[*Note that such areas of knowledge will be significantly developed after graduation, through learning and experience at work, and the expected level of attainment from an undergraduate programme will naturally be that of a fresh graduate, not that of an experienced engineer*].

A3.2 Learning Outcomes – Level B

Students graduating from an accredited programme will:

- Have a knowledge and understanding of laboratory practice, and able to operate bench- (or larger) scale chemical engineering equipment.
- Be able to undertake well-planned experimental work and to interpret, analyse and report on experimental data.
- Be able to find and apply, with judgement, information from technical literature and other sources.
- Be aware of the importance of codes of practice and industry standards and have some experience in applying them.
- Be aware of quality assurance issues and their application to continuous improvement.
- Be aware of the range of applications of chemical engineering and the roles of chemical engineers.
- Be aware of the concept and implications of 'professional' (chartered) engineers and the role of Professional Engineering Institutions.

A3.3 Learning Outcomes – Level F

Students graduating from an accredited programme will:

- Understand the limitations of current practice.
- Be aware of research and developments in relevant technologies and their potential impact on current practice.
- Have undertaken research and/or development project work that provides opportunities for: application of research methods; originality and experience in dealing with uncertainty and new concepts and/or applications.
- Have communicated the outcomes of the project work in a professional manner that may include: thesis; publication; poster; presentation.

A4. Chemical Engineering Design Practice & Design Projects

A4.1 Introduction

Chemical engineering design is the creation of a system, process, product or plant to meet an identified need.

Students must display competence in chemical engineering design, which requires bringing together technical and other skills, the ability to define a problem and identify constraints, the employment of creativity and innovation. They must understand the concept of 'fitness for purpose' and the importance of delivery.

Departments should demonstrate high standards of appreciation of Safety, Health and Environment (SH&E) within their teaching of design and related project work.

Chemical engineering design is the creation of a system, process, product, or plant to meet an identified need. Design is an essential component of all IChemE-accredited degrees and serves to:

- Develop an integrated approach to chemical engineering.
- Encourage the application of chemical engineering principles to problems of current and future industrial relevance including sustainable development, safety, and environmental issues.
- Encourage students to develop and demonstrate creative and critical powers by requiring choices and decisions to be made in areas of uncertainty.
- Encourage students to take a broad view when confronted with complexity arising from the interaction and integration of the different parts of a process or system.
- Encourage the development of transferable skills such as communication and team working.
- Give students confidence in their ability to apply their technical knowledge to real problems.

IChemE is keen to encourage innovation and diversity in design and to encourage a wide range of applications, which might include:

- Process design – synthesis of unit operations into a manufacturing process to meet a specification.
- Process troubleshooting/debottlenecking – analysis of problems for an existing process for which the solutions require innovative process or equipment changes.
- Equipment design – the design of specific and complex equipment items to deliver a process or product objective, e.g. extruder, distillation column, etc.
- Product design.
- Product troubleshooting – analysis of problems for an existing product for which innovative solutions are required.
- System design – where creativity, broad range thinking, and systems integration are needed to design a system to meet a specification, e.g. manufacturing supply chain, effluent handling system, transportation system, safety auditing system, recycling system, site utility system, product distribution system.

It is desirable that the learning outcomes for design are achieved throughout the programme: for example, by students accumulating a portfolio of design work as they progress through the programme. This approach will develop students' ability to handle a range of process, product and plant design problems, provide them with a wide variety of design experience, and will encourage integration of design-related aspects into the taught programme.

In order to meet the learning outcomes associated with the systems approach, the design portfolio must include a major design exercise which addresses the complexity issues arising from the interaction and integration of the different parts of a process or system. It is expected that this major project will be undertaken by teams of students and that this will contribute significantly to the development of the students' transferable skills such as communication and team working.

While team-working in design and design projects is actively encouraged, IChemE expects that the assessment methods will be effective in ensuring that each individual student, as well as the whole team, meets the required learning outcomes.

A4.2 Learning Outcomes – Level B

Students graduating from an accredited programme will:

- Understand the importance of identifying the objectives and context of the design in terms of: the business requirements; the technical requirements; sustainable development; safety, health and environmental issues; appreciation of public perception and concerns.
- Understand that design is an open-ended process, lacking a pre-determined solution, which requires: synthesis, innovation and creativity; choices on the basis of incomplete and contradictory information; decision making; working with constraints and multiple objectives; justification of the choices and decisions taken.
- Be able to deploy chemical engineering knowledge using rigorous calculation and results analysis to arrive at and verify the realism of the chosen design.
- Be able to take a systems approach to design appreciating: complexity; interaction; integration.
- Be able to work in a team and understand and manage the processes of: peer challenge; planning, prioritising and organising team activity; the discipline of mutual dependency.
- Be able to communicate effectively to: acquire input information; present the outcomes of the design clearly, concisely and with the appropriate amount of detail, including flowsheets and stream data; explain and defend chosen design options and decisions taken.

A4.3 Learning Outcomes at Level F

Students graduating from an accredited programme will:

- Have a comprehensive understanding of design processes and methodologies and an ability to apply and adapt them in unfamiliar situations.
- Be able 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.
- Have the ability to generate an innovative design for processes, systems and products to fulfil new needs.
- Have achieved, within the design project(s) some of the 'Depth' and 'Breadth' Outcomes of Advanced Chemical Engineering at Masters Level described in Section A6. For example:
  - Detailed design of control systems based on process dynamics;
  - Design and operation aspects of start-up and shut-down;
  - Design of a process for a novel product for which data are unreliable or limited;
  - Environmental impact and Life Cycle Analysis;
  - Evaluation of financial and other risks.

A5. Embedded Learning

A5.1 Introduction

Chemical engineers must develop general skills that will be of value in a wide range of business situations. These include development of abilities within problem solving, communication, effective working with others, effective use of IT, persuasive report writing, information retrieval, presentation skills, project planning, self learning, performance improvement, awareness of the benefits of continuing professional development etc.

IChemE expects degree programmes to be designed so that they provide the opportunity to acquire and develop these skills and will seek to ensure demonstration and commitment to this objective.

Chemical engineers must develop a range of general 'transferable' (or 'professional') skills. IChemE expects degree programmes to be designed so that the opportunity to acquire and develop these skills, in different ways and at different levels, is embedded throughout the programme.

In order to encourage the embedding and integration of these skills throughout the programme, a minimum credit count is not specified. However, IChemE expects that evidence will be provided to demonstrate where and how the learning outcomes are met.

A5.2 Learning Outcomes

Students graduating from an accredited programme will:

- Have developed a wide range of problem-solving skills.
- Have developed a range of effective communication skills including written reports and presentations.
- Recognise the importance of working effectively with others and have acquired a range of experience in achieving this.
- Recognise the importance of leadership skills and have had some opportunity to acquire these.
- Be effective users of IT.
- Recognise the importance of project planning and time management and have acquired a range of experience in achieving these.
- Be able to reflect on their own work and implement strategies for personal improvement and professional development.
- Be aware of the benefits of continuing professional development and of personal development planning.

A6. Advanced Chemical Engineering at Level F

Advanced Chemical Engineering outcomes at Level F will build on the Level B outcomes set out in A2 to A4.

Students graduating from an accredited programme with outcomes at Level F will, in addition:

- Have the ability to handle uncertainty and complexity.
- Have the ability to familiarize themselves with the new and unknown.
- Have the ability to develop innovative approaches.
- Have some understanding of the limits of available technology and of the potential of new and emerging technology.
- Have a broader understanding of related subjects.

These outcomes can be achieved through a combination of 'Depth' and Breadth':

A6.1 Achievement of Level F Depth learning outcomes

'Depth' requires knowledge and understanding beyond Level B, and the achievement of more challenging learning outcomes, for subjects within Core Chemical Engineering. Such 'Depth' subjects will usually be characterized by having clearly distinguishable pre-requisites from an earlier stage in the programme. 'Depth' subjects may also develop a research strength or specialism of the department.

A6.2 Achievement of Level F Breadth learning outcomes

Chemical engineering is a broad, multi-faceted and expanding discipline. This provides opportunities for accredited M- and F-Standard programmes to include subjects in addition to Core Chemical Engineering. IChemE welcomes this, particularly where the Level F 'Breadth' subjects reflect a strength or specialism of the Department (either research strengths and/or a focus on specific industry sectors). In distinction to 'Depth' subjects, 'Breadth' subjects will in general not depend on specific pre-requisites from an earlier stage in the programme.

It is expected that such 'Breadth' subjects will be related to Chemical Engineering in its widest sense at Level F. Subjects that are at an introductory level, or would be an introductory level in other programmes, would be unlikely to meet the learning outcomes at Level F.

A6.3 Other Level F outcomes

Level F in chemical engineering practice and chemical engineering design should reflect the general advanced abilities listed above. Specific Level F outcomes for these topics are given in Sections 3.3 and 4.3 above.

A7. Complementary Subjects

Accredited degree programmes may contain other subjects that are not directly related to chemical engineering, such as languages, business and management related studies, history and culture, etc. IChemE recognises the benefits of a rounded education in effectively preparing graduates for their careers. Complementary subjects are not formally assessed by IChemE as for programme accreditation, but rigour in their teaching and assessment is expected.

Appendix B

Learning Outcomes at Level D

B1 Underpinning mathematics, science (chemistry, physics, biology) and associated engineering disciplines

B1.1 Introduction

Students' knowledge and understanding of mathematics, science and associated engineering disciplines should be of appropriate depth and breadth to underpin their chemical engineering education, to enable appreciation of its scientific and engineering context, and to support their understanding of future developments. It is expected that this underpinning material should be taught in an engineering context and, where appropriate, a chemical engineering context.

The amount of underpinning mathematics and science will vary between programmes, particularly reflecting variations in entry qualifications and/or structure of the earlier year(s) of the programmes. Departments will need to provide evidence that students have achieved the levels in these topics to underpin all the other required Learning Outcomes in chemical engineering.

B1.2 Learning outcomes – Level D

Students graduating from an accredited programme will:

- Have a knowledge and understanding of mathematics necessary to support applications of key chemical engineering principles and processes.
- Be able to apply the basic mathematical models relevant to chemical engineering.
- Have a knowledge and understanding of the core scientific principles, namely the relevant aspects of physics, chemistry, biochemistry, biology and materials science, to enable the understanding of chemical engineering principles.
- Have a basic understanding of relevant elements from engineering disciplines commonly associated with chemical engineering, such as electrical power and motors; microelectronics; mechanics of pressure vessels; structural mechanics.

B2. Core Chemical Engineering

B2.1 Introduction

Core chemical engineering comprises the main principles and applications of chemical engineering. *Students graduating from an accredited programme will*:

- Understand the principles of fluids and solids formation and processing.
- Be capable of applying these principles to problems involving fluid flow, heat transfer, mass transfer and reaction engineering.
- Be able to apply the principles to solve routine problems of complex systems within a structured approach to safety, health and sustainability.

It is desirable that throughout the programme the students should gain experience of the broad range of applications of the principles and appreciate the importance of analysing and modelling systems. The applications should include:

- Different types of process, including continuous and batch; chemical processes and bioprocesses.
- Different time scales: short and long periods; steady and unsteady state.
- Different physical scales: from molecular level to large scale continuous.

Students should have gained an insight into the requirement to handle broader implications of work as a chemical engineer. These include sustainability aspects; process safety, health, environmental and other professional issues including ethics, risk, commercial and economic considerations etc.

B2.2 Fundamentals – Level D

Students graduating from an accredited programme will:

- Understand the principles of material and energy balances.
- Be familiar with the thermodynamic and transport properties of fluids, solids and multiphase systems.

- Be familiar with the principles of momentum, heat and mass transfer, and be able to apply them to problems involving flowing fluids and multiple phases.
- Be able to apply basic thermodynamic analysis to processes with heat and work transfer.
- Be familiar with and able to apply to routine problems the principles of equilibrium and chemical thermodynamics.
- Be familiar with and able to apply to routine problems the principles of chemical reaction and reactor engineering.

B2.3 Mathematical Modelling and Quantitative Methods – Level D

Students graduating from an accredited programme will:

- Be aware of and able to apply routine tools for mathematical modelling.
- Be aware of empirical correlation and other approximate methods.
- Be aware of the importance of numerical and computer methods and able to use industry-standard chemical engineering software for solving chemical engineering problems (detailed knowledge of computer coding is not required).

B2.4 Process and Product Technology – Level D

This is a broad heading that includes: the 'unit operations' of separation and mixing; particle technology; equipment sizing and performance.

Students graduating from an accredited programme will:

- Be familiar with and be able to apply methods to analyse the characteristics and performance of a range of typical mixing, separation, and similar processing steps for fluids, particulates and multi-phases.
- Be familiar with the principles on which processing equipment operates, and be able to apply methods to determine equipment size and performance of common items such as reactors, exchangers and columns.
- Be familiar with and be able to estimate the effect of processing steps upon the state of the material being processed, and on the end product in terms of its composition, morphology and functionality.

B2.5 Systems – Level D

Students graduating from an accredited programme will:

- Be familiar with the principles of batch and continuous operation and criteria for process selection.
- Be able to integrate process steps into a sequence and apply analysis techniques such as balances (mass, energy).
- Be aware of system dynamics, and be able to operate and modify performance of measurement and control functions.

B2.6 Process Safety – Level D

Students graduating from an accredited programme will:

- Be familiar with the inherent nature of safety and loss prevention, and the principal hazard sources in chemical and related processes – including flammability, explosivity and toxicity (including biological hazards).
- Be familiar with the principles of risk assessment and of safety management, and be able to apply techniques for the assessment and abatement of process and product hazards.
- Be aware of the methods of identifying process hazards (e.g. HAZOP), and of assessing environmental impact.
- Be aware of specialist aspects of safety and environmental issues, such as noise, hazardous area classification, relief and blowdown, fault tree analysis,
- Have broad knowledge of the local legislative framework and how it is applied to the management of safety, health and environment in practice and in the workplace, from the perspectives of all involved, including operators, designers, contractors, researchers, visitors and the public.

B2.6.1 Safety Culture – Level D

In addition to the above 'taught' outcomes, it is expected that students' learning and teaching will be undertaken in an environment (Department, School, etc) where there is an obviously strong and effective safety culture and where the students will learn by example.

Thus, *students graduating from an accredited programme will understand that*: an effective Safety, Health and Environment (SH&E) culture includes:

- Leadership – Head of Department and Senior Management take an active part in SH&E.
- Visibility – clear and relevant signage and information; good standards of housekeeping in laboratories.
- Behaviour – staff, students and visitors behave in a careful, risk averse manner; Personal Protective Equipment is available and usage is enforced; there are systems for incident reporting, follow-up, feedback and improvement.
- Legislative Compliance – there is a sound understanding of, and compliance with, applicable SH&E legislation.

- Risk Assessment and Management – Risk Assessment and Permit to Work systems are in place; those who use them are fully conversant with their roles and responsibilities.

B2.7 Sustainability and Economics, Ethics – Level D

Students graduating from an accredited programme will:

- Be familiar with the principles of sustainability (environmental, social and economic) and appreciate when they should be applied.
- Understand the main methods of minimizing the environmental impact on air, water, land, and integrated eco-systems, including waste minimization at source and 'end-of-pipe' methods.
- Be aware of the principles of process, plant and project economics.
- Understand the need for high ethical and professional standards and understand how they are applied to issues facing engineers.

B2.7.1 Ethics Culture – Level D

Although 'taught' ethics is not excluded, it is not an essential requirement of an accredited programme. It is expected that the 'taught' outcomes in areas such as safety, sustainability and economics, together with the awareness of the code of conduct and professionalism, will lead to an embedded ethics culture.

Thus, *students graduating from an accredited programme will understand that*: an effective ethics culture includes:

- how sustainability, economics, health and safety and professionalism are informed by and influence the ethical reasoning and behaviour of the professional engineer

B3. Chemical Engineering Practice

B3.1 Introduction

Chemical engineering practice is the practical application of chemical engineering skills, combining theory and experience, together with the use of other relevant knowledge and skills.

Graduates of accredited programmes must understand the ways in which chemical engineering knowledge can be applied in practice, such as in: operations and management; projects; providing services or consultancy; developing new technology.

Departments should demonstrate high standards of appreciation and practice of Safety, Health and Environment (SH&E) in their teaching and operations within laboratories, pilot plants and project work.

Typical learning outcomes include: possession of practical and laboratory skills relevant to chemical engineering; knowledge of the characteristics of particular equipment, processes or products; the ability to deal with technical uncertainty; appreciation of the sources and value of technical literature; awareness of the nature of intellectual property; facility in the use of appropriate codes of practice and industry standards.

[*Note that such areas of knowledge will be significantly developed after graduation, through learning and experience at work, and the expected level of attainment from an undergraduate programme will naturally be that of a fresh graduate, not that of an experienced engineer*].

B3.2 Learning Outcomes – Level D

Students graduating from an accredited programme will:

- Have a knowledge and understanding of laboratory practice, and able to operate bench- (or larger) scale chemical engineering equipment.
- Be able to undertake well-planned experimental work and to interpret, analyse and report on experimental data.
- Be able to find and apply, with judgement, information from technical literature and other sources.
- Be aware of the importance of codes of practice and industry standards and have some experience in applying them.
- Be aware of quality assurance issues and their application to continuous improvement.
- Be aware of the range of applications of chemical engineering and the roles of chemical engineers.
- Be aware of the concept and implications of 'professional' (chartered and incorporated) engineers and the role of Professional Engineering Institutions.

B4. Chemical Engineering Design Practice & Design Projects

B4.1 Introduction

Chemical engineering design is the creation of a system, process, product or plant to meet an identified need.

Students must display competence in chemical engineering design, which requires bringing together technical and other skills, the ability to define a problem and identify constraints, the employment of creativity and innovation. They must understand the concept of 'fitness for purpose' and the importance of delivery.

Departments should demonstrate high standards of appreciation of Safety, Health and Environment (SH&E) within their teaching of design and related project work.

Chemical engineering design is the creation of a system, process, product, or plant to meet an identified need. Design is an essential component of all IChemE-accredited degrees and serves to:

- Develop an integrated approach to chemical engineering.
- Encourage the application of chemical engineering principles to problems of current and future industrial relevance including sustainable development, safety, and environmental issues.
- Encourage students to develop and demonstrate creative and critical powers by requiring choices and decisions to be made in areas of uncertainty.
- Encourage students to take a broad view when confronted with complexity arising from the interaction and integration of the different parts of a process or system.
- Encourage the development of transferable skills such as communication and team working.
- Give students confidence in their ability to apply their technical knowledge to real problems.

IChemE is keen to encourage innovation and diversity in design and to encourage a wide range of applications, which might include:

- Process design – synthesis of unit operations into a manufacturing process to meet a specification.
- Process troubleshooting/debottlenecking – analysis of problems for an existing process for which the solutions require innovative process or equipment changes.
- Equipment design – the design of specific and complex equipment items to deliver a process or product objective, e.g. extruder, distillation column, etc.
- Product design.
- Product troubleshooting – analysis of problems for an existing product for which innovative solutions are required.
- System design – where creativity, broad range thinking, and systems integration are needed to design a system to meet a specification, e.g. manufacturing supply chain, effluent handling system, transportation system, safety auditing system, recycling system, site utility system, product distribution system.

It is desirable that the learning outcomes for design are achieved throughout the programme: for example, by students accumulating a portfolio of design work as they progress through the programme. This approach will develop students' ability to handle a range of process, product and plant design problems, provide them with a wide variety of design experience, and will encourage integration of design-related aspects into the taught programme.

In order to meet the learning outcomes associated with the systems approach, the design portfolio must include a major design exercise which addresses the complexity issues arising from the interaction and integration of the different parts of a process or system. It is expected that this major project will be undertaken by teams of students and that this will contribute significantly to the development of the students' transferable skills such as communication and team working.

While team-working in design and design projects is actively encouraged, IChemE expects that the assessment methods will be effective in ensuring that each individual student, as well as the whole team, meets the required learning outcomes.

B4.2 Learning Outcomes – Level D

Students graduating from an accredited programme will:

- Be aware of the importance of identifying the objectives and context of the design in terms of: the business requirements; the technical requirements; sustainable development; safety, health and environmental issues; appreciation of public perception and concerns.
- Appreciate that design is an open-ended process, lacking a pre-determined solution, which requires: synthesis, innovation and creativity; choices on the basis of incomplete and contradictory information; decision making; working with constraints and multiple objectives; justification of the choices and decisions taken.
- Be able to deploy chemical engineering knowledge using rigorous calculation and results analysis to arrive at and verify the realism of the chosen design.
- Be able to take a systems approach to design appreciating: complexity; interaction; integration.

- Be able to work in a team and understand and manage the processes of: peer challenge; planning, prioritising and organising team activity; the discipline of mutual dependency.
- Be able to communicate effectively to: acquire input information; present the outcomes of the design clearly, concisely and with the appropriate amount of detail, including flowsheets and stream data; explain and defend chosen design options and decisions taken.

B5. Embedded Learning

B5.1 Introduction

Chemical engineers should develop general skills that will be of value in a wide range of business situations. These include development of abilities within problem solving, communication, effective working with others, effective use of IT, persuasive report writing, information retrieval, presentation skills, project operation, self learning, performance improvement, awareness of the benefits of continuing professional development etc.

IChemE expects these programmes to be designed so that they provide the opportunity to acquire and develop these skills and will seek to ensure demonstration and commitment to this objective.

Chemical engineers should develop a range of general 'transferable' (or 'professional') skills. IChemE expects these programmes to be designed so that the opportunity to acquire and develop these skills, in different ways and at different levels, is embedded throughout the programme.

In order to encourage the embedding and integration of these skills throughout the programme, a minimum credit count is not specified. However, IChemE expects that evidence will be provided to demonstrate where and how the learning outcomes are met.

B5.2 Learning Outcomes –Level D

Students graduating from an accredited programme will:

- Have developed an appreciation of problem-solving skills.
- Have developed effective communication skills including written reports and presentations.
- Recognise the importance of working effectively with others and have acquired a range of experience in achieving this.
- Appreciate the importance of leadership skills and have had some opportunity to acquire these.
- Be effective users of IT.
- Recognise the importance of project operation and time management and have acquired a range of experience in achieving these.
- Be able to reflect on their own work to generate strategies for personal improvement and professional development.
- Be aware of the benefits of continuing professional development and of personal development planning.

B6. Complementary Subjects

Accredited programmes may contain other subjects that are not directly related to chemical engineering, such as languages, business and management related studies, history and culture, etc. IChemE recognises the benefits of a rounded education in effectively preparing graduates for their careers. Complementary subjects are not formally assessed by IChemE as for programme accreditation, but rigour in their teaching and assessment is expected.

Appendix C

IChemE outcome level descriptors

IChemE defines three outcome levels based on European Qualifications Framework levels 5, 6 and 7*. Each of the levels is defined by a set of descriptors for Knowledge, Understanding & Skills and Competence to be applied to the learning outcomes at that level (given in Appendices A and B).

IChemE Level / Outcome	Level D (EQF level 5)	Level B (EQF level 6)	Level F (EQF level 7)
Theoretical and/or factual knowledge	Comprehensive, specialised, factual and theoretical knowledge within chemical engineering and an awareness of the boundaries of that knowledge	Advanced knowledge of chemical engineering, involving a critical understanding of theories and principles	Highly specialised knowledge, some of which is at the forefront of knowledge in chemical engineering, as the basis for original thinking and/or research Critical awareness of knowledge issues in chemical engineering and its interface with different fields
Understanding and Skills *In this context, skill is described as* • *cognitive (involving the use of logical, intuitive and creative thinking), and* • *practical (involving manual dexterity and the use of methods, materials, tools and instruments)*	A comprehensive range of cognitive and practical skills required to develop creative solutions to abstract problems	Advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in chemical engineering	Specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields
Competence *In this context, competence is described in terms of responsibility and autonomy.*	Exercise management and supervision in contexts of study or work activities where there is unpredictable change; review and develop performance of self and others	Manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable study or work contexts	Manage and transform study or work contexts that are complex, unpredictable and require new strategic approaches; take responsibility for contributing to professional knowledge and practice

* See: https://ec.europa.eu/ploteus/en/content/descriptors-page

Appendix D

Typical schedule for an assessment visit

Day 0

19:00 Pre-visit meeting of assessors

Day 1

08:45 Assessors arrive at the department

09:00 Welcome to the department – introductions, orientation

10:00 Private panel review of materials

11:00 Meet with senior staff (as appropriate: Dean, Head of Department, Programme Directors etc) to discuss programme philosophy and future plans

11:30 Meet with programme directors to discuss the degree programme questionnaire – entry standards and programme structure, curriculum, learning outcomes (to be continued after lunch)

13:00 Working lunch with academic staff

14:00 Continued discussion of degree programme curriculum and specific learning outcomes

15:00 Discuss design content of degree programme(s)

15:30 Informal coffee break, possibly including technical and support staff

16:00 Discuss Level F (advanced) outcomes and other major projects

16:30 Review day 1 with programme directors (an opportunity to guide the programme and materials required for day 2)

17:00 Meet a representative group of students - including (if possible) some recent graduates – (no staff to be present)

18:00 Close of Day 1

Day 2

09:00 Visit teaching laboratories, computing facilities and other resources, e.g. library, project rooms etc

11:00 Private panel discussion/break

11:30 Discuss achievement of embedded learning outcomes

12:00 Discuss industrial/professional training aspects

13:00 Private panel lunch

14:00 Discuss assessment and quality assurance aspects

14:45 Private panel discussion

15:45 Final review and discussion with head of department and programme directors

16:30 Close

Appendix E

Education & Accreditation Forum
Indicative criteria for accreditation decisions

Present status	How well are IChemE requirements met? Learning outcomes, resources, QA, safety culture etc	Indicative decision*
Programme not accredited by IChemE	Fully met, or Substantially met with only insignificant or very minor deficiencies	Accredit for up to 3 yrs. If the programme is a relatively minor variant of an existing IChemE-accredited programme, the period may be up to 5 years.
	Substantially met but with relatively minor deficiencies which are anticipated as straightforward to remedy	Accredit with mandatory Conditions and time limit for these to be remedied (typically 1 or 2 years).
	Not met due to significant** and important deviations from IChemE requirements	Cannot be accredited in its present form.
Programme accredited by IChemE and presented for re-accreditation	Fully met, or Substantially met with only insignificant or very minor deficiencies	Accredit for up to 5 yrs.
	Substantially met but with relatively minor deficiencies which are anticipated as straightforward to remedy	Accredit for up to 5 yrs with Recommendations. The expectation is that these will usually be addressed within that timescale and reviewed at the next accreditation visit.
	Not met due to significant** and important deviations from IChemE requirements	Where the problems were not previously evident, accredit with Conditions and time limit for these to be remedied (typically 1 or 2 years). Or, where these are historic problems, highlighted in previous IChemE reports or conditions, the accredited standard may be reduced or accreditation may be withdrawn until the problems have been remedied. Or, in exceptional cases, where problems are so great as to cast severe doubt on the capabilities of the graduates or otherwise to pose reputational risk to IChemE, immediate withdrawal of accreditation or other sanctions may be appropriate.

*NB In all cases:

indefinite Conditions may also be imposed for issues which cannot be addressed by modification to the programme or its delivery. E.g. A particular pathway within a programme.

IChemE may recommend non-mandatory actions referred to as recommendations. The expectation is that these will usually be addressed within the accreditation period and reviewed at the next accreditation visit.

**Definition of Significant – examples include: shortfalls in Health and Safety culture; some learning outcomes below IChemE-defined standards; some learning outcomes a little below IChemE credit requirements

Appendix F

Glossary of terms used in the guidelines

See cross-referenced sections for further details.
Where relevant, definitions have been adopted from the Engineering Council AHEP

Term	*Definition*	*Section*
Academic formation	The educational process of obtaining the qualifications necessary for IChemE membership.	2.2
Accreditation	The process of peer review of an academic programme against IChemE's published learning outcomes, as described in these guidelines.	
Assessor	A person appointed by IChemE who is trained in assessing the suitability of a programme for accreditation	7.2
Awareness	Learning Outcome descriptor for general familiarity (with the subject material)	3.7
B-Standard	Accreditation level for first cycle degrees that provide a solid academic foundation in chemical engineering knowledge and skills at IChemE outcome Level B.	2.1
Bologna process	A non-statutory inter-governmental agreement, creating a coherent and cohesive European Higher Education Area (EHEA) and a Framework for Qualifications of the European Higher Education Area (FQ-EHEA) comprising first, second and third cycle degrees. The EHEA is a means of promoting mutual recognition of qualifications, demonstrating transparency of systems and easing the mobility of staff and students across higher education in Europe. www.ehea.info. The UK has verified that its national frameworks for higher education qualifications in England, Wales and Northern Ireland and in Scotland are compatible with the FQ-EHEA: Bachelors and Bachelors (Hons) degrees as first cycle, the Integrated MEng and Masters degree as second cycle. Other jurisdictions have also adopted or recognise the general principles of the Bologna process. www.qaa.ac.uk/Publications/InformationAndGuidance/Documents/BolognaLeaflet.pdf	
Breadth	'Breadth' subjects will be related to Chemical Engineering in its widest sense and would be at an appropriate advanced level, which do not depend on specific pre-requisites from an earlier stage in the programme (see also Depth).	A6.2
Chartered Chemical Engineer	Professional title available to individuals who meet the required standard of competence and commitment. See www.icheme.org/membership.aspx.	2.2
Compensation	The system by which, in some assessment schemes, it is possible for students to compensate for poor performance in one module by achieving better marks in other modules.	4.6
Complementary learning	Substantial topics in a programme which are additional to the IChemE accreditation learning outcomes	3.9
Complex	Learning Outcome descriptor for engineering problems, processes or equipment which involve dealing simultaneously with a sizeable number of factors which interact and require deep understanding, including knowledge at the forefront of the discipline	3.7
Condition (of accreditation)	Where continued accreditation is dependent upon the department meeting requirements set by IChemE. Conditions are binding on the department and must be resolved within the indicated timeframe for accreditation to be maintained and valid.	8.2.2
Content	The material taught in a programme, as opposed to the learning outcomes achieved. In order to ensure that all required Learning Outcomes are met, IChemE provides guidance on the minimum expected content for each area and for the programme as a whole, specified in terms of minimum Credits.	4.1

Term	*Definition*	*Section*
Credit	A measure of the content of a programme. 1 Credit is equivalent to approximately 20 hours student workload (combined Tutor-led and independent study).	4.1
Department	The term "department" is used for convenience throughout these guidelines for the academic unit (i.e. department, school, faculty etc) responsible for delivering the programmes under review.	
Depth	Greater knowledge and understanding, and the achievement of more challenging learning outcomes, for subjects within Core Chemical Engineering (see also Breadth). 'Depth' subjects will usually be characterized by having clearly distinguishable pre-requisites from an earlier stage in the programme.	A6.1
D-Standard	Accreditation level for sub-degree programmes that provide a solid academic foundation in chemical engineering knowledge and skills with learning outcomes at IChemE Level D	2.1
EAF	Education and Accreditation Forum – IChemE's committee with delegated decision-making authority for all matters relating to the accreditation of university programmes.	
Embedded learning	Learning which is developed in the context of other activities (e.g. ethics and safety culture developed in the context of general practical working).	4.2, A5, B5
Evidence	Auditable material supporting the accreditation application, for example samples of marked student work, information on programme structure, academic quality review reports etc	6.1
First cycle	A programme at level 6 in the European Qualifications Framework (EQF) – see https://ec.europa.eu/ploteus/content/descriptors-page	
F-Standard	Accreditation level for postgraduate degrees of the highest international standards that provide advanced chemical engineering knowledge and skills at IChemE outcome level F.	2.1
Incorporated Chemical Engineer	Professional title available to individuals who meet the required standard of competence and commitment. See http://www.icheme.org/membership/associate.aspx	2.2
Integrated programme	A programme which integrates outcome Levels B and F into a single award.	4.2.1
Knowledge	Learning Outcome descriptor for information that can be recalled	3.7
Learning outcome	Also known as programme outcomes or programme learning outcomes. A statement of achievement expected of a graduate from an accredited programme.	3
M-Standard	Accreditation standard for integrated degrees of the highest international standards that provide both the solid academic foundation in chemical engineering of a first cycle degree and the advanced chemical engineering knowledge and skills of a second cycle degree, at IChemE outcome levels B and F.	2.1
Programme	A set of courses of study that leads to the award of a degree or other higher education qualification.	
Qualification	The award made as a result of successful completion of a programme of study	2.1
Questionnaire	The proforma used by IChemE to collect data about programmes to be assessed for accreditation.	I & III
Resources	The staff, facilities, and learning materials supporting a programme of study.	4.7
Second cycle	A programme at level 7 in the European Qualifications Framework (EQF) – see https://ec.europa.eu/ploteus/content/descriptors-page	
Skills	Learning Outcome descriptor for acquired and learned attributes that can be applied almost automatically.	3.7
Understanding	Learning Outcome descriptor for the capacity to use concepts creatively, for example: in problem solving; in design; in explanations and in diagnosis.	3.7
University	The term "university" is used for convenience throughout these guidelines to represent all kinds of higher educational establishment including universities, polytechnics and colleges.	

Getting help

IChemE specialist staff will be happy to advise the departments on any aspect of the accreditation process.

We recognise that each application is unique and will be pleased to help departments achieve ambitions for recognition of their degree programmes. Questions on accreditation are best directed by email to accreditation@icheme.org

Departments can contact IChemE through a variety of channels:

In UK (Global headquarters):

Tel: +44 (0)1788 578214
Fax: +44 (0)1788 560833
Email: accreditation@icheme.org

Mail: Head of Education Affairs
Qualifications Department
The Institution of Chemical Engineers,
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