Accreditation Criteria
for
Engineering Education Programmes
Accreditation Criteria
which apply to
Engineering Education Programmes
designed to meet the
Education Standard required for Registration of

Chartered Engineers
Associate Engineers
Engineering Technicians
FOREWORD

Through the *Institution of Civil Engineers of Ireland (Charter Amendment Act, 1969)*, Engineers Ireland has as one of its purposes:

*Setting up and maintaining proper standards of professional and general education and training for admission to membership or to any category of membership of the Institution…*

Engineers Ireland, in fulfilment of this purpose, has formally accredited engineering degree programmes in the Republic of Ireland since 1982. The accreditation function of Engineers Ireland is carried out by its Accreditation Board.

Engineering education programmes which satisfy the appropriate criteria laid down in this document are deemed to meet the education standard required of individuals seeking one of the Registered Professional Titles of Chartered Engineer, Associate Engineer and Engineering Technician.

Under international agreements such as the Washington, Sydney and Dublin Accords, accreditation decisions of Engineers Ireland are accepted in the signatory countries on the same basis as their “home” graduates. Details of these agreements can be found on our website, www.engineersireland.ie

Engineers Ireland is a member of FEANI (The European Federation of National Engineering Associations). FEANI publishes an *Index of Approved Engineering Schools and Courses* in its 25 European member countries. All engineering degree programmes accredited by Engineers Ireland as satisfying the education standard for the title of Chartered Engineer are listed in the Index and accepted in the member countries of FEANI.

In formulating this fourth edition of its accreditation criteria, Engineers Ireland had regard to the criteria of its international partners and like them, has based its approach firmly on the basis of programme outcomes.

Included in this edition are accreditation criteria for Master Degree (level 9) programmes, designed to satisfy the higher education standard for the title of Chartered Engineer. The accredited Master Degree programme will replace the accredited honours Bachelor Degree programme as the education standard required for the Chartered Engineer title from programmes completed in 2013. The evolving introduction of the new standard will require a reconsideration of the definition and competences of a Chartered Engineer.

Engineers Ireland will continue to work closely with the universities and institutes of technology to ensure the maintenance and improvement of the quality of engineering education in Ireland.
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PART 1:

EDUCATION STANDARD REQUIRED

FOR

REGISTRATION OF

CHARTERED ENGINEERS
Note on the Education Standard for the Chartered Engineer Title and the MIEI Grade

With effect from programmes completed in 2013, the education standard for the professional title of Chartered Engineer will be a Master degree in engineering (Level 9) as defined in Section B of Part 1 of this document.

The education standard for the grade of MIEI will remain an honours Bachelor of Engineering degree (Level 8) as defined in Section A of Part 1 of this document, up to 2018.
1.1 Definition of a Chartered Engineer

The following is the definition of a professional engineer recognised by the Council of Engineers Ireland for the title Chartered Engineer and is the definition adopted in 1960 by the Conference of Engineering Societies of Western Europe and the United States of America (EUSEC):

A Chartered Engineer is competent by virtue of his/her fundamental education and training to apply the scientific method and outlook to the analysis and solution of engineering problems. He/she is able to assume personal responsibility for the development and application of engineering science and knowledge, notably in research, design, construction, manufacturing, superintending, managing and in the education of the engineer. His/her work is predominantly intellectual and varied and not of a routine mental or physical character. It requires the exercise of original thought and judgement and the ability to supervise the technical and administrative work of others.

His/her education will have been such as to make him/her capable of closely and continuously following progress in his/her branch of engineering science by consulting newly published works on a worldwide basis, assimilating such information and applying it independently. He/she is thus placed in a position to make contributions to the development of engineering science or its applications.

His/her education and training will have been such that he/she will have acquired a broad and general appreciation of the engineering sciences as well as a thorough insight into the special features of his/her own branch. In due time he/she will be able to give authoritative technical advice and to assume responsibility for the direction of important tasks in his/her branch.

1.2 Formation of a Chartered Engineer

The formation of a Chartered Engineer takes a minimum of eight years and consists of two phases.

The first phase consists of studying and successfully completing an engineering degree programme accredited by Engineers Ireland as meeting the education standard required for the title Chartered Engineer.

The second phase is called Initial Professional Development and generally involves the achievement of the competences necessary to apply engineering principles to the solution of engineering problems. This phase is described in detail in Engineers Ireland’s publication Chartered Engineer – Regulations for the title of Chartered Engineer.

1.3 Education Standard required for the title Chartered Engineer

(a) The education standard required for the title of Chartered Engineer is as exemplified by a degree in engineering approved by the Council of Engineers Ireland.

(b) Each candidate for election or transfer to the title of Chartered Engineer shall possess one of the following qualifications;

(i) A degree in engineering approved by the Council of Engineers Ireland as satisfying the education standard for the title of Chartered Engineer;
(ii) The Postgraduate Diploma of Engineers Ireland;
(iii) An engineering qualification which Engineers Ireland, through an international agreement, recognises as satisfying the education standard for the title of Chartered Engineer;
(iv) Other engineering qualifications deemed by the Council of Engineers Ireland to satisfy the education standard for the title of Chartered Engineer.
1.4 General Description of an Accredited Engineering Degree Programme

An accredited engineering degree programme which meets the education standard required for the title of Chartered Engineer, is one which is approved by the Executive Committee of the Council of Engineers Ireland, on the recommendation of the Accreditation Board, as satisfying the criteria described in Part 1 of this document.

A Accreditation Criteria for Honours Bachelor Degree (level 8) Programmes

A.1.5 Programme Outcomes

Engineers Ireland specifies the following programme outcomes which apply to all honours Bachelor degree (level 8) engineering programmes aimed at satisfying the education standard for the title of Chartered Engineer up to 2012*. Programmes must enable graduates to demonstrate:

(a) The ability to derive and apply solutions from a knowledge of sciences, engineering sciences, technology and mathematics;
(b) The ability to identify, formulate, analyse and solve engineering problems;
(c) The ability to design a system, component or process to meet specified needs, to design and conduct experiments and to analyse and interpret data;
(d) An understanding of the need for high ethical standards in the practice of engineering, including the responsibilities of the engineering profession towards people and the environment;
(e) The ability to work effectively as an individual, in teams and in multi-disciplinary settings together with the capacity to undertake lifelong learning;
(f) The ability to communicate effectively with the engineering community and with society at large.

A.1.6 Programme Area Descriptors

A.1.6.1 Engineers Ireland has determined that the study of six programme areas is necessary if engineering graduates are to achieve the programme outcomes described in A.1.5.

These programme areas are:
- Sciences and Mathematics
- Discipline-specific Technology
- Information and Communications Technology
- Design and Development
- Engineering Practice
- Social and Business Context

A.1.6.2 Programme area descriptors outline how each programme area can contribute to the achievement of the programme outcomes by the engineering graduate. These are described below.

(a) Sciences and Mathematics

The study of the sciences provides the basic intellectual tools which engineers use to understand and harness the forces of the world. Students need to develop a good understanding of the sciences in general and, depending on their chosen discipline, they will study specific sciences in greater depth. This understanding forms the basis on which the engineering sciences of their chosen discipline will be further developed, sometimes to the boundaries of the field, within their programme of study.

Engineering and science are strongly quantitative, as expressed through the language of mathematics. Engineers need to be numerate and well versed in the mathematical methods needed to understand the underlying sciences of their discipline. Students also need the mathematical tools to study the operation and modelling of engineering systems to achieve optimal design.

* From 2013, an accredited Honours Bachelor Degree (level 8) Programme will satisfy only the education standard for Membership (MIEI) and will not satisfy the education standard for Chartered Engineer.
(b) Discipline-specific Technology
Technology is commonly perceived in two ways – the sum total of artefacts designed for practical purposes and the knowledge and skills associated with the structure, function, operation and application of practical artefacts. Engineers use science and technology (in both these forms) to create products and systems which themselves often constitute new technologies. It is important therefore that engineers are thoroughly versed in the technologies (usually engineering technologies) relevant to their chosen discipline. Examples would include: telecommunications, power systems, control systems, algorithms, data structures, manufacturing processes, highway construction etc. On the skills side of technology, students will need to be able to work with the latest software/hardware and to develop the related skills in the laboratory, workshop and projects.

(c) Information and Communications Technology (ICT)
ICT provides support throughout engineering and acts as an aid to communication. A basic knowledge of the principles of ICT is therefore required, with understanding of how it pervades the practice of engineering. Information Technology is essential to the exercise of the engineering activity both in the education of engineers and the practice of engineering.

Closely linked to mathematical studies is the effective use of computer techniques. Students should be taught to use computers for the quantitative analysis, simulation, solution and communication of engineering problems. They should also be able to evaluate and use industry-standard software tools and numerical analysis packages.

ICT also provides a valuable tool for the manipulation and presentation of engineering information. Engineers should be skilled in the use of a wide variety of computer-based data presentation techniques.

(d) Design and Development
Design is at the heart of engineering and is where professional engineers demonstrate their creativity and innovation. Design studies will include consideration of general principles of design and of techniques specific to particular engineering products and processes. Whilst it may be difficult to teach creativity itself, students should learn to think beyond the obvious and routine, be encouraged to try novel solutions to existing problems and be given the opportunity to meet the challenge of previously unsolved problems. By this means, the required awareness of the creative process may be formed. Since engineering is ultimately about practical activities, such innovation should include the practical testing of ideas in the laboratory or conducting research for information to develop them further. These activities should be linked to technical analysis and the critical evaluation of results.

(e) Engineering Practice
The success of new engineering activity is closely related to earlier experience. Engineers need to be familiar with general engineering practice and with the particular practices of their discipline. Principal amongst these will be the methodology of design and operational practice within their discipline. Related to this is responding to real life situations and day to day management of engineering projects – supervising others, dealing with technical uncertainty and having awareness of codes of practice and the regulatory framework. Operational practice will include knowledge of manufacturing or development processes, methods of control of engineering products and processes, the assessment of hazards and operational safety. Students need to be aware of the practical dimension of their work, which should be developed in projects, laboratories, workshops and visits to industrial or commercial installations.

(f) Social and Business Context
Engineering is directed to developing, providing and maintaining infrastructure, goods, systems and services for industry and the community. Programmes need to develop an awareness of the social and commercial context of the engineer’s work. This includes an understanding of the constraints imposed by health and safety, the environment, codes of practice, politics, the law and financial viability; and the means by which the various risks may be assessed and managed. Students should be aware of the various methods for the assessment of quality and fitness for purpose of engineering products and systems and understand how to achieve these attributes in design and development. Programmes
should develop the student’s ability to analyse, present and communicate technical information to a range of audiences. Society expects professional behaviour from its professional engineers and therefore within programmes, students should become familiar with the expectations and standards inherent in professional codes of conduct. Students should learn how to identify their own learning needs.

A.1.7 Assessment of Student Performance

Examinations, projects and other assessment instruments should be designed to evaluate the extent to which students can demonstrate achievement of the programme outcomes both throughout the programme and at its conclusion.

The emphasis in examinations should be on analysis and problem-solving and not on the recitation of facts or standard solutions.

The quality assurance process of the programme provider should seek to ensure that adequacy of standards is achieved in all examinations.

A.1.8 Guidelines on Programme Structure and Resources

Engineers Ireland is primarily concerned to ensure that programmes for accreditation are designed so that students are enabled to achieve the programme outcomes specified. It does not prescribe the education standard of students entering programmes and the learning process they undertake during a programme as these are, generally, matters best dealt with by programme providers.

However, the wide experience of Engineers Ireland with accreditation has shown that certain minimum inputs, i.e. entry standards, programme duration and structure and resources including buildings, laboratories, equipment, academic and support staff, have been required in the past if programme outcomes are to be satisfactorily achieved. Those inputs are listed in A.1.8.1, A.1.8.2 and A.1.8.3. If providers wish to propose alternatives they must present a detailed case indicating how programme outcomes will be met.

A.1.8.1 Guidelines on Entry Standards

(a) The entry standard to an engineering programme should be such that those holding it have a reasonable prospect of understanding the learning materials provided and of achieving the programme outcomes.

(b) Engineers Ireland accepts the following minimum entry standards for admission to accredited Honours Bachelor of Engineering degree programmes:

Four year *ab initio* Bachelor Degree Programmes (level 8)

- A grade D3 or better in four Ordinary Level Leaving Certificate subjects
  - Plus
  - A grade C3 or better in two Higher Level Leaving Certificate subjects, one of which shall be Mathematics.

  *Where an entrant has a C3 in Higher Level Applied Mathematics, a D3 in Higher Level Mathematics is acceptable.*

  *A pass in an approved entrance examination in Mathematics is acceptable in lieu of the C3 in Higher Level Mathematics.*

- A pass in a Foundation Course approved by Engineers Ireland.

(c) Programme providers may propose alternative entry requirements, which must satisfy the criteria in A.1.8.1(a).
A.1.8.2 Guidelines on Programme Duration and Structure

Engineers Ireland accepts the following programme durations and structures:

(a) Four year integrated _ab initio_ programme leading to a Bachelor degree at level 8 in the National Framework of Qualifications. The student effort required should be such as to merit 240 ECTS credits.

(b) Two year Bachelor degree (level 7) programme preceded by a one year Ordinary Degree in Engineering or Engineering Technology and a two year Higher Certificate in Engineering (level 6) programme (5 years in total). The student effort required should be such as to merit 300 ECTS credits.

Engineers Ireland considers that this awards structure is such that it is very difficult to design and implement curricula which will enable students to achieve the programme outcomes described in A.1.5. Therefore, accreditation of such programmes will be offered only on a short-term basis. It is noted that the entry standard to these programmes is an Ordinary Degree in Engineering or Engineering Technology with Merit Grade 2 approved by Engineers Ireland plus a Distinction level grade or mark in Mathematics in the Examination.

A.1.8.3 Guidelines on Resources including buildings, laboratories, equipment, academic and support staff

(a) Buildings, Laboratories and Equipment

The buildings, laboratories and equipment should be such as to satisfactorily support the learning process of the student in achieving the programme outcomes.

(b) Academic Staff

There should be sufficient numbers of academic staff to ensure the effective delivery of the programme outcomes.

Staff teaching on engineering degree programmes should:

- Be involved in research work as evidenced by participation in national and international conferences and publishing in refereed journals,
- Be involved with industry by secondment, consulting and ongoing industry-led research,
- Generally, have obtained post-graduate research degrees,
- Be able to demonstrate their professional competence by having undertaken significant post-graduate work in industry/engineering consultancy and/or research and development; this is normally demonstrated through the acquisition of the Chartered Engineer title.
- Have the ability to design, develop and implement courses on an accredited engineering degree programme.

(c) Support Staff

- Engineering programmes require substantial inputs from non-engineering personnel in areas such as mathematics, the sciences, business management and other complementary studies. The quality of such staff is as important as that of the engineering staff and the same general standards apply.
- There should be an adequate number of technical and laboratory staff to ensure that there is a satisfactory level of technical support in workshops and laboratories.

A.1.8.4 Guidelines on Student Transfer and Mobility

Engineers Ireland is committed to supporting the policies of the National Qualifications Authority of Ireland in respect of facilitating access, transfer and progression for students. Programme providers should have in place procedures and regulations, consistent with maintaining academic standards, to achieve this.
Accreditation Criteria for Master’s Degree (level 9) Programmes

B.1.5 Programme Outcomes

Engineers Ireland specifies the following programme outcomes which apply to Master’s degree engineering programmes (level 9) aimed at satisfying the education standard which will apply to the title of Chartered Engineer from 2013. It is to be understood that these programme outcomes are achieved through the learning outcomes of all modules in all years of the Master’s degree programme and any preceding Bachelor’s degree programmes. Programmes must enable graduates to demonstrate:

a) Knowledge and understanding of the mathematics, sciences, engineering sciences and technologies underpinning their branch of engineering.

Graduates should have, *inter alia*;
(i) knowledge and understanding of the principles, concepts, limitations and range of applicability of established mathematical tools and methods;
(ii) knowledge and understanding of the theoretical bases and the related assumptions underpinning the engineering sciences relevant to their engineering discipline;
(iii) knowledge and understanding of a wide range of engineering materials, processes and components;
(iv) knowledge and understanding of related developing technologies and how they might impinge upon their branch of engineering;

b) The ability to identify, formulate, analyse and solve engineering problems.

Graduates should, *inter alia*, be able to;
(i) integrate knowledge, handle complexity and formulate judgements with incomplete or limited information;
(ii) create models by deriving appropriate equations and by specifying boundary conditions and underlying assumptions and limitations;
(iii) identify and use appropriate mathematical methods for application to new and ill-defined engineering problems;
(iv) identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques;
(v) develop software tools including numerical techniques to solve engineering problems.

c) The ability to design components, systems or processes to meet specific needs.

Graduates should have, *inter alia*;
(i) knowledge and understanding of design processes and techniques and the ability to apply them in unfamiliar situations;
(ii) ability to apply design methods to unfamiliar, ill-defined problems, possibly involving other disciplines;
(iii) ability to investigate and define a need and identify constraints including environmental and sustainability limitations, health and safety and risk assessment issues;
(iv) knowledge and understanding of codes of practice and industry standards and the need for their application;
(v) ability to redesign products, processes or systems in order to improve productivity, quality, safety and other desired needs.

d) The ability to design and conduct experiments and to apply a range of standard and specialised research tools and techniques.

Graduates should, *inter alia*, be able to;
(i) extract, through literature search or experiment, information pertinent to an unfamiliar problem;
(ii) design and conduct experiments and to analyse and interpret data;
(iii) evaluate critically, current problems and new insights at the forefront of the particular branch of engineering;
(iv) incorporate aspects of engineering outside their own discipline and to consult and work with experts in other fields;
(v) contribute individually to the development of scientific/technological knowledge in one or more areas of their engineering discipline.

e) **Understanding of the need for high ethical standards in the practice of engineering, including the responsibilities of the engineering profession towards people and the environment.**

Graduates should have, *inter alia*;
(i) ability to reflect on social and ethical responsibilities linked to the application of their knowledge and judgements;
(ii) knowledge and understanding of the social, environmental, ethical, economic, financial, institutional and commercial considerations affecting the exercise of their engineering discipline;
(iii) knowledge and understanding of the health, safety and legal issues and responsibilities of engineering practice and the impact of engineering solutions in a societal and environmental context;
(iv) knowledge and understanding of the importance of the engineer’s role in society and the need for the highest ethical standards of practice;
(v) knowledge and understanding of the framework of relevant legal requirements governing engineering activities, including personnel, environmental, health, safety and risk issues.

f) **The ability to work effectively as an individual, in teams and in multi-disciplinary settings, together with the capacity to undertake lifelong learning.**

Graduates should have, *inter alia*;
(i) ability to recognise and make use of the interactions between the engineering technologies and the technologies associated with other disciplines and professions;
(ii) ability to consult and work with experts in various fields in the realisation of a product or system;
(iii) knowledge and understanding of the respective functions of technicians, technologists and engineers and how they together constitute the engineering team;
(iv) knowledge and understanding of group dynamics and ability to exercise leadership;
(v) ability to plan and carry through, self-directed Continuing Professional Development to improve their own knowledge and competence;
(vi) knowledge and understanding of concepts from a range of areas outside engineering.

g) **The ability to communicate effectively with the engineering community and with society at large.**

Graduates should be able to, *inter alia*;
(i) select and apply appropriate communication tools in order to create deeper understanding and maximum impact on a given audience;
(ii) describe succinctly, the relevant advantages and disadvantages of the various technologies to a lay audience;
(iii) communicate effectively in public, national and international contexts;
(iv) write technical papers and reports and synthesise their own work and that of others in abstracts and executive summaries;
(v) understand the training needs of others in appropriate engineering techniques.
B.1.6 Programme Area Descriptors

B.1.6.1 Engineers Ireland has determined that the study of six Programme Areas is necessary if graduates are to achieve the Programme Outcomes described in B.1.5. Programme Areas are largely coterminous, but it is recognised that occasional overlap is unavoidable.

The Programme Areas are:

(a) Sciences and Mathematics
(b) Discipline-specific Technology
(c) Software and Information Systems
(d) Creativity and Innovation
(e) Engineering Practice
(f) Social and Business Context

B.1.6.2 Programme Area descriptors outline how each Programme Area, through the learning outcomes of its constituent modules, can contribute to the achievement of the Programme Outcomes by the engineering graduate. This process is described below.

(a) Sciences and Mathematics
The study of the sciences provides the basic intellectual tools which graduate engineers use to understand and harness the forces of the world. Students need to develop a good understanding of the sciences in general and, depending on their chosen discipline, they will study specific sciences in greater depth. This understanding forms the basis on which the engineering sciences of their chosen discipline will be further developed, sometimes to the boundaries of the field, within their programme of study. Students should be encouraged to reflect upon standard theories and their inherent assumptions, and, where necessary, adapt them to particular circumstances.

Engineering and science are strongly quantitative, as expressed through the language of mathematics. Engineers need to be numerate and well versed in the mathematical methods required to understand and apply the underlying sciences of their discipline. Students also need the mathematical tools to allow them to develop, validate, apply and adapt models of engineering components and systems in order to achieve optimal design.

(b) Discipline-specific Technology
Technology is commonly perceived in two ways – the sum total of artefacts designed for practical purposes and the knowledge and skills associated with the structure, function, operation and application of practical artefacts. Engineers use science and technology (in both these forms) to create products and systems which themselves often constitute new technologies. It is important therefore that graduate engineers are thoroughly versed in the engineering technologies relevant to their chosen discipline. Examples would include; telecommunications, power systems, control systems, algorithms, data structures, manufacturing processes, highway construction etc. Students should also have the opportunity to become involved in multi-disciplinary projects which require them to draw upon technologies outside their immediate area of interest.

On the skills side of technology, students will need to be able to work with the latest software/hardware and to develop the related skills in the laboratory, workshop and projects.

(c) Software and Information Systems
Software and information systems are used throughout the whole field of engineering to facilitate the solution of engineering problems and the communication of engineering decisions.

The solution of engineering problems is facilitated by techniques such as structured information retrieval and filtering, simulation and quantitative analysis. Engineering students should therefore be taught the theory underlying those software and information systems which are of particular significance to engineering practice. The teaching of these topics will rely heavily on the students’ knowledge of the
relevant mathematical techniques. Students will also require instruction in the skills of using computers for the quantitative analysis, simulation, and solution of engineering problems. They should be shown how to apply, to adapt and, where necessary, through data exchange, to integrate industry-standard software tools and information systems.

Software, information systems and the electronic encapsulation of knowledge play an important role in the manipulation and communication of engineering information. Students will therefore require skills in the use of software tools like word processors, presentation packages and spreadsheets for these purposes. They should be introduced to a wide range of computer-based data presentation techniques and should learn how to choose the most appropriate one for a particular set of circumstances.

(d) Creativity and Innovation
Research and design are central components of creativity and innovation. Research seeks to generate new knowledge which may lead, through the design process, to new products and systems. This Programme Area should facilitate students’ understanding of the experimental method and how its application can lead to new knowledge and insights in an organised way. Students should be exposed to a range of standard and specialised research tools and techniques of inquiry and should have the opportunity to draw up and execute, independently, a research plan.

Design is at the heart of engineering. Design studies should include consideration of the design process and of techniques specific to particular engineering products and processes. Students should be encouraged to think beyond the obvious and routine, and be given opportunities to face the challenges of previously unsolved problems. For example, consideration should be given to including in the programme, the art of problem solving, heuristics, TRIZ, etc. By these means, a student’s ability to contribute to the creative process may be developed.

Since engineering is ultimately about practical activities, such innovation should include the practical testing of ideas in the laboratory and conducting research for information to develop these further. These activities should be linked to technical analysis and the critical evaluation of results. Also related to practical issues, students should explore the various steps from idea to marketplace, including patents, business planning and technology transfer. In both research and design, students should have the opportunity to be involved in multi-disciplinary projects.

(e) Engineering Practice
The success of new engineering development is often closely related to earlier experience. Students need to be familiar with general engineering practice and with the particular operational practices of their discipline. Related to this is responding to real life situations and day-to-day management of complex engineering projects – supervising others, dealing with technical uncertainty and having awareness of codes of practice and the regulatory framework. Operational practice will develop students’ knowledge of manufacturing or development processes, methods of control of engineering products and processes, the assessment of hazards and operational safety.

Students should be made aware of the practical dimension of their work. Various pedagogical approaches can facilitate the development of this awareness, including case studies, industrial placements, projects, industry speakers, laboratories, workshops and visits to industrial or commercial installations.

(f) Social and Business Context
Engineering is directed to developing, providing and maintaining infrastructure, goods, systems and services for industry and the community. Programmes need to develop an awareness of the social and commercial context of the engineer’s work. This includes an understanding of issues relating to today’s multi-cultural workforce, of socio-technology and of the constraints on technological developments imposed by health and safety, the environment, codes of practice, politics, the law and financial viability, management issues and the means by which the various risks may be assessed and managed. Students should be made aware of the various methods for the assessment of quality and fitness for purpose of engineering products and systems, and understand how to achieve these attributes in design and
development. They should be given ample opportunity to analyse and discuss the ethical consequences of their decisions.

Engineering invariably involves a team approach; it is important therefore that students learn how to work with and for others, both within and outside their own disciplines. They should have some knowledge of team dynamics and should be capable of exercising leadership. Programmes should develop the student’s ability to analyse, present and communicate technical information to a range of audiences.

Society expects professional behaviour from its professional engineers and therefore programmes should enable students to become familiar with the expectations and standards inherent in professional codes of conduct.

The importance of students identifying their own learning needs and exercising responsibility for their own continuing professional development should be stressed.

B.1.7 Assessment of Student Performance

Examinations, projects and other assessment instruments should be designed to evaluate the extent to which students can demonstrate achievement of the programme outcomes both throughout the programme and at its conclusion.

The emphasis in examinations should be on analysis and problem-solving and not on the recitation of facts or standard solutions.

The quality assurance process of the programme provider should seek to ensure that adequacy of standards is achieved in all examinations.

B.1.8 Guidelines on Programme Structure and Resources

Engineers Ireland is primarily concerned to ensure that programmes for accreditation are designed so that students are enabled to achieve the programme outcomes specified. It does not prescribe the education standard of students entering programmes and the learning process they undertake during a programme as these are, generally, matters best dealt with by programme providers.

However, the wide experience of Engineers Ireland with accreditation has shown that certain minimum inputs, i.e. entry standards, programme duration and structure and resources including buildings, laboratories, equipment, academic and support staff, have been required in the past if programme outcomes are to be satisfactorily achieved. Those inputs are listed in B.1.8.1, B.1.8.2 and B.1.8.3. If providers wish to propose alternatives they must present a detailed case indicating how programme outcomes will be met.

B.1.8.1 Guidelines on Entry Standards

B.1.8.1.1 The entry standard to an engineering programme should be such that those holding it have a reasonable prospect of understanding the learning materials provided and of achieving the programme outcomes.

B.1.8.1.2 Engineers Ireland accepts the following minimum entry standards:

(a) Five year (300 ECTS Credits) integrated programmes leading to a Master’s Degree.

- A grade D3 or better in four Ordinary Level Leaving Certificate subjects

  Plus

  A grade C3 or better in two Higher Level Leaving Certificate subjects, one of which shall be Mathematics.

  Where an entrant has a C3 in Higher Level Applied Mathematics, a D3 in Higher Level Mathematics is acceptable.

  A pass in an approved entrance examination in Mathematics is acceptable in lieu of the C3 in Higher Level Mathematics.
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- A pass in a Foundation Course approved by Engineers Ireland.
- Programme providers may propose alternative entry requirements, which must satisfy the criteria in B.1.8.2.1.

(b) Five year (300 ECTS Credits) programmes leading to a Master’s Degree with a Bachelor’s degree awarded on successful completion of years three or four.

(i) Entry standard for the Bachelor’s Degree is as in B.1.8.2.2 (a).

(ii) Entry standard to the One or Two-year Master’s Degree.
  - A pass or better in the Bachelor’s degree.
  - A pass or better in a cognate Bachelor’s degree, the entry standard to which is as in B.1.8.2.2 (a).

Note:
Those holding accredited Ordinary degrees (level 7) in engineering would normally be expected to successfully complete an approved programme of Bridging Studies before transferring into the latter stages of a five-year Master’s degree programme.

B.1.8.2 Guidelines on Programme Duration and Structure

Engineers Ireland accepts the following durations and structures which are in line with its position on the Bologna Declaration:

a) Five-year (300 ECTS Credits) integrated programmes leading to a Master’s Degree.

b) Five-year (300 ECTS Credits) programmes leading to a Master’s Degree with a Bachelor’s degree awarded on successful completion of years three or four.

B.1.8.3 Guidelines on Resources including buildings, laboratories, equipment, academic and support staff

B.1.8.3.1 Buildings, Laboratories and Equipment
The buildings, laboratories and equipment should be such as to satisfactorily support the learning process of the student in achieving the programme outcomes.

B.1.8.3.2 Academic Staff
There should be sufficient numbers of academic staff to ensure the effective delivery of the programme outcomes.
Staff teaching on engineering degree programmes should:
- Be involved in research work as evidenced by participation in national and international conferences and publishing in refereed journals,
- Be involved with industry by secondment, consulting and ongoing industry-led research,
- Generally, have obtained post-graduate research degrees,
- Be able to demonstrate their professional competence by having undertaken significant post-graduate work in industry/engineering consultancy and/or research and development; this is normally demonstrated through the acquisition of the Chartered Engineer title.
- Have the ability to design, develop and implement courses on an accredited engineering degree programme.

B.1.8.3.3 Support Staff
Engineering programmes require substantial inputs from non-engineering personnel in areas such as mathematics, the sciences, business management and other complementary studies. The quality of such staff is as important as that of the engineering staff and the same general standards apply.
There should be an adequate number of technical and laboratory staff to ensure that there is a satisfactory level of technical support in workshops and laboratories.
B.1.8.4 Guidelines on Student Transfer and Mobility

Engineers Ireland is committed to supporting the policies of the National Qualifications Authority of Ireland in respect of facilitating access, transfer and progression for students. Programme providers should have in place procedures and regulations, consistent with maintaining academic standards, to achieve this.

The principal objective of the Bologna Declaration is to create a European Area of Higher Education in which student mobility easily takes place, primarily by Bachelor degree graduates transferring to Master degree programmes in other European countries.
PART 2:

EDUCATION STANDARD REQUIRED FOR REGISTRATION OF ASSOCIATE ENGINEERS
2.1 Definition of an Associate Engineer

The Associate Engineer is competent to apply in a responsible manner current engineering technologies in a chosen field. He/she exercises independent technical judgement and works with significant autonomy within his/her allocated responsibility. The performance of his/her engineering technology work requires an understanding of relevant financial, commercial, statutory, safety, management, social and environmental considerations.

2.2 Formation of an Associate Engineer

The formation of an Associate Engineer takes a minimum of seven years and consists of two phases.

The first phase consists of studying and successfully completing an engineering technology degree or diploma programme accredited by Engineers Ireland as meeting the education standard required for the title Associate Engineer.

The second phase is called Initial Professional Development and generally involves the achievement of the competences necessary to apply engineering technology principles to the solution of engineering technology problems. This phase is described in detail in Engineers Ireland’s publication Associate Engineer – Regulations for the title of Associate Engineer.

2.3 Education Standard required for the title Associate Engineer

(a) The education standard required for the title of Associate Engineer is as exemplified by a degree/diploma in engineering technology/technology approved by the Council of Engineers Ireland.

(b) Each candidate for election or transfer to the title of Associate Engineer shall possess one of the following qualifications:

(i) a degree in engineering technology approved by the Council of Engineers Ireland as satisfying the education standard for the title of Associate Engineer;
(ii) a National or Technician Diploma in Engineering technology approved by the Council of Engineers Ireland as satisfying the education standard for the title of Associate Engineer;
(iii) an engineering technology qualification which the Council of Engineers Ireland, through an international agreement, recognises as satisfying the education standard for the title of Associate Engineer;
(iv) other engineering technology qualifications deemed by Engineers Ireland to satisfy the education standard for the title of Associate Engineer.

2.4 General Description of an Accredited Engineering Technology Programme

An accredited engineering technology degree or diploma programme which meets the education standard required for the title of Associate Engineer, is one which is approved by the Executive Committee of Council on the recommendation of the Accreditation Board, as satisfying the criteria described in Part 2 of this document.

2.5 Programme Outcomes

Engineers Ireland specifies Programme Outcomes which apply to engineering technology programmes aimed at satisfying the education standard for the title of Associate Engineer. Programmes must enable graduates to demonstrate:
(a) Knowledge and understanding of the mathematics, sciences, engineering technology sciences and technologies related to the particular branch of engineering technology.

Graduates should be able to demonstrate knowledge and understanding of, *inter alia*;
(i) the advantages and limitations of a range of established and relevant mathematical techniques;
(ii) the empirical and theoretical bases of the relevant engineering technology sciences;
(iii) the types and properties of the materials related to their particular branch of engineering technology, including their scientific explanation;
(iv) the principles, applications and limitations of the technologies central to their chosen branch of engineering technology;

(b) Ability to identify, formulate and solve broadly-defined problems in the particular branch of engineering technology.

Graduates should be able to demonstrate, *inter alia*;
(i) knowledge and understanding of problem-solving methodology;
(ii) ability to select and apply an appropriate mathematical/analytical/numerical method to a broadly-defined engineering technology problem;
(iii) ability to create mathematical models by deriving appropriate equations, and specifying boundary conditions and underlying assumptions and limitations;
(iv) ability to use and, where necessary, to adapt existing software tools for the solution of broadly-defined engineering technology problems.

(c) Ability to contribute to the design of components, systems and processes to meet specified needs.

Graduates should be able to demonstrate, *inter alia*;
(i) knowledge and understanding of design processes and techniques;
(ii) ability to apply design processes to broadly-defined engineering problems;
(iii) ability to use industry-standard design tools and processes;
(iv) knowledge and understanding of codes of practice and industrial standards.

(d) Ability to conduct investigations to facilitate the solution of broadly-defined problems within the particular branch of engineering technology.

Graduates should be able to demonstrate, *inter alia*;
(i) ability to design and conduct experiments, and analyse and interpret data;
(ii) ability to gather relevant data from codes, data bases and other sources, and to generate data using a range of laboratory and workshop equipment;
(iii) ability to select and apply appropriate instrumentation and techniques for fault-finding and performance testing;
(iv) ability, under supervision, to conduct research into broadly-defined issues related to the particular branch of engineering technology.

(e) Understanding of the need for high ethical standards in the practice of engineering, including the responsibilities of the engineering profession towards people and the environment.

Graduates should be able to demonstrate, *inter alia*;
(i) knowledge and understanding of the importance of the engineer's role in society and the need for the highest ethical standards of practice;
(ii) consideration of social and environmental factors during the design process;
(iii) understanding of the scientific basis of the environmental hazards potentially inherent in engineering technology systems;
(iv) knowledge and understanding of the potential health, safety and risk issues of engineering technology projects, including the relevant legislation.
(f) Ability to work effectively as an individual, in teams and in multi-disciplinary settings together with the capacity to undertake lifelong learning.

Graduates should be able to demonstrate, *inter alia*;
(i) ability to plan and carry through, self-directed Continuing Professional Development to improve their knowledge and competence;
(ii) ability to work effectively as a member of a team;
(iii) ability to consult and work with experts in various fields in the realisation of a project;
(iv) knowledge and understanding of the respective functions of technicians, technologists and engineers and how they together constitute the engineering team.

(g) Ability to communicate effectively with the engineering community and with society at large.

Graduates should be able to demonstrate, *inter alia*;
(i) ability to select and apply appropriate communication tools in order to create deeper understanding and maximum impact on a given audience;
(ii) ability to describe succinctly the relevant advantages and disadvantages of their chosen engineering technology to a lay audience;
(iii) ability to write technical papers and reports and synthesise their work in abstracts and executive summaries;
(iv) ability to defend a particular thesis before a panel of peers.

2.6 Programme Area Descriptors

Engineers Ireland has determined that the study of six Programme Areas is necessary if graduates are to achieve the stated Programme Outcomes. The Programme Areas, listed below, are largely coterminous, but occasional overlap may be unavoidable.

(a) Science and Mathematics
(b) Discipline-specific Technology
(c) Software and Information Systems
(d) Design and Development
(e) Engineering Technology Practice
(f) Social and Business Context

Programme Area descriptors outline how each Programme Area, through the Learning Outcomes of its constituent modules, facilitates the engineering technology graduate's achievement of the stated Programme Outcomes.

(a) Science and Mathematics
This Programme Area should provide students with a good understanding of the basic sciences and engineering sciences, sufficient to underpin adequately the dominant engineering technologies of the chosen field. The utility of this scientific material should be liberally demonstrated through the use of case studies and application to technical problems of increasing complexity. In the latter years of the programme, students should be encouraged to seek out the latest scientific advances and adapt them, where appropriate, for application to engineering problems.

Engineering and science are strongly quantitative, as expressed through the language of mathematics. Engineering technologists need to be numerate and to understand the mathematical bases of the engineering sciences related to their discipline. As with scientific knowledge, mathematical knowledge and skills should be presented against a background of practical application. Students should be given ample opportunity to apply a range of standard mathematical techniques to a range of engineering problems.

Students should also receive instruction in the mathematical methods for developing, validating and applying models of engineering technology components and systems in order to achieve optimal design.
(b) Discipline-specific Technology
Technology is commonly perceived in two ways – the sum total of artefacts designed for practical purposes and the knowledge and skills associated with the structure, function, operation and application of practical artefacts. Associate Engineers have to be competent to apply the engineering technologies central to their chosen discipline. Examples would include; telecommunications, power systems, control systems, algorithms, data structures, manufacturing processes, highway construction and so on.

It is important, therefore, that engineering technology programmes place a primary focus on the understanding and application of known technologies. However, students should be encouraged to seek out new technologies, to understand and adapt them, where appropriate, for use in the solution of engineering problems. These should include technologies outside their immediate area of interest. Students should be aware of the relative environmental impacts of the various technologies.

On the skills side of technology, students should be given ample opportunity to use and apply the latest software/hardware components and systems. The programme should help them develop the necessary skills in laboratories, workshops and projects. Industrial visits, placements and cooperative education schemes offer immense potential for the improvement of the students’ technological skills. Students’ knowledge of the engineering technologies will be demonstrated in design projects, laboratory reports and projects.

(c) Software and Information Systems
Software and information systems are commonly employed throughout the whole field of engineering to facilitate the solution of engineering problems and the communication of knowledge and decisions. Engineering technology students should be able to apply these tools in the field.

The mathematics underpinning these systems are often complex; for example, techniques such as structured information retrieval and filtering are in common use today. Whilst engineering technology students will require a basic understanding of the related mathematics, their major strength should lie in the ability to use these systems as tools for the solution of engineering problems.

Students should develop facility in the use of computers for the quantitative analysis, simulation and solution of engineering problems. Students should also have experience in the application of industry-standard software and numerical analysis packages to engineering problems. They should be shown how to apply, to adapt and, where necessary, through data exchange, to integrate industry-standard software tools and information systems.

Software and information systems and the electronic encapsulation of knowledge play an important role in the manipulation of, and the communication of, engineering information. Students will therefore require skills in the use of software tools like word processors, presentation packages and spreadsheets for these purposes. They should be introduced to a wide range of computer-based data presentation techniques and should know how to choose the most appropriate one for a particular set of circumstances.

(d) Design and Development
Engineering technologists make valuable contributions to the design process. They have to resolve the practical problems related to the implementation of designs led by Chartered Engineers. This requires, inter alia, the development of details within those designs, the execution of tests to generate necessary data and to validate assumptions used in the designs, the procurement of the necessary equipment and materials and the verification of the performance of the resultant artefacts or systems.

It is important, therefore, that engineering technology programmes give due consideration to the general principles of design, and explain the techniques specific to particular engineering products and processes. Students should learn about the various steps from idea to marketplace, including patents, business planning and technology transfer. Since engineering technology is primarily concerned with application, the programme should require students to carry out designs through both mini and major projects. This could be achieved, advantageously, on a team basis, involving, where possible, students on engineering and engineering technician programmes.
The Associate Engineer has an important role to play in the development of products and processes. Students should therefore have opportunity to test performance in the laboratory, in the workshop, in the simulation laboratory and in the field (where possible). That experience, combined with case studies of similar products, should be used for the refinement, the reengineering and the development of particular designs. Students should be encouraged to think beyond the obvious and routine and be given opportunities to face the challenges of previously unsolved problems.

(e) Engineering Practice
Engineering practice is the *sine qua non* of the engineering technologist. Programmes should explore the industrial environment where graduates are likely to apply their knowledge and skills, including markets, competitors, management structures, and the financial, commercial and environmental constraints faced by industry. The role and the career opportunities of Associate Engineers in these industries should be clarified.

Engineering success is often the outcome of an evolutionary process based on incremental advances upon earlier experiences. It is essential, therefore, that engineering technologists are thoroughly conversant with general engineering practice as well as the particular operational practices of their chosen discipline. Principal amongst these will be operational practices in common use within their discipline, including an awareness of codes of practice and the regulatory framework. Operational practice will include knowledge of manufacturing and development processes, quality assurance, project management, methods of control of engineering products and processes, the assessment and control of environmental impacts, risk management, operational safety and the elimination of hazards in the workplace.

Students should be made aware of the practical dimension of their work. Various pedagogical approaches can facilitate the development of this awareness and of the related skills, including case studies, industrial placements, projects, industry speakers, laboratories, workshops and visits to industrial or commercial installations. The mechanisms and benefits of technology transfer between industry and academe should be explained.

(f) Social and Business Context
Engineering is directed to developing, providing and maintaining infrastructure, goods, systems and services for industry and the community. Related education programmes need to develop an awareness of the social and commercial context of the engineer’s work. This includes an understanding of issues related to today’s multi-cultural workforce, of socio-technology and of the constraints on technological developments imposed by health and safety, the environment, codes of practice, politics, the law and financial viability and the means by which the various risks may be assessed and managed. Students should be made aware of the various methods for the assessment of quality and fitness for purpose of engineering products and systems and understand how to achieve these attributes in design and development. They should be given ample opportunity to analyse and discuss the ethical consequences of their decisions. Engineering invariably involves a team approach; it is important, therefore, that students learn how to work with and for others, both within and outside their own disciplines. They should have some knowledge of team dynamics and should be capable of exercising leadership. Programmes should develop the student’s ability to analyse, present and communicate technical information to a range of audiences.

Society expects professional behaviour from its professional engineers and therefore within programmes, students should become familiar with the expectations and standards inherent in professional codes of conduct. Students should learn how to identify their own learning needs.

The importance of students identifying their own learning needs and exercising responsibility for their own continuing professional development should be stressed.
2.7 Assessment of Student Performance

Examinations, projects and other assessment instruments should be designed to evaluate the extent to which students can demonstrate achievement of the programme outcomes both throughout the programme and at its conclusion.

The quality assurance process of the programme provider should seek to ensure that adequacy of standards is achieved in all examinations.

2.8 Guidelines on Programme Structure and Resources

Engineers Ireland is primarily concerned to ensure that programmes for accreditation are designed so that graduates are enabled to achieve the programme outcomes specified. It does not prescribe the education standard of students entering programmes and the learning process they undertake during a programme, as these are, generally, matters best dealt with by programme providers.

However, Engineers Ireland's wide experience of accreditation has shown that certain minimum inputs i.e. entry standards, programme duration and structure, and resources including buildings, laboratories, equipment, academic and support staff, have been required in the past if programme outcomes are to be satisfactorily achieved. Those inputs are listed in 2.8.1, 2.8.2 and 2.8.3. If providers wish to propose alternatives, they must present a detailed case indicating how programme outcomes will be met.

2.8.1 Guidelines on Entry Standards

(a) The entry standard to an engineering technology programme should be such that those holding it have a reasonable prospect of understanding the learning materials provided and of achieving the programme outcomes.

(b) Engineers Ireland accepts the following minimum entry standards for admission to approved engineering technology programmes:

(i) One year Ordinary Degree in Engineering/Engineering Technology (level 7)
   ■ Merit Grade 2 in a Higher Certificate in Engineering approved by Engineers Ireland

(ii) Ab initio three year Ordinary Degree in Engineering/Engineering Technology (level 7)
   ■ A grade D3 or better in five Ordinary Level subjects in the Leaving Certificate including Mathematics and English

(c) Programme providers may propose alternative entry requirements, which must satisfy the criteria in 2.8.1(a).

2.8.2 Guidelines on Programme Duration and Structure

(a) Engineers Ireland accepts the following programme durations and structures

   i. Three or four years ab initio
   ii. One year following a two year Higher Certificate programme

(b) The student effort required should be such as to merit 180-240 ECTS credits

2.8.3 Guidelines on Resources including buildings, laboratories, equipment, academic and support staff

(a) Buildings, Laboratories and Equipment

The buildings, laboratories and equipment should be such as to satisfactorily support the learning process of the student in achieving the programme outcomes.
(b) Academic Staff

There should be a sufficient number of academic staff to ensure the effective delivery of the programme outcomes.

Staff teaching on engineering technology programmes should:

■ Be involved with industry by secondment, consulting and ongoing industry-led research,
■ Be able to demonstrate their professional competence by having undertaken post-graduate work in industry/engineering consultancy and/or research and development; this is normally demonstrated through the acquisition of the Chartered Engineer title,
■ Have the ability to design, develop and implement courses on an accredited engineering technology programme.

(c) Support Staff

■ Engineering technology programmes require substantial inputs from non-engineering personnel in areas such as mathematics, the sciences, business management and other complementary studies. The quality of such staff is as important as that of the engineering staff and the same general standards apply.
■ There should be an adequate number of technical and laboratory staff to ensure that there is a satisfactory level of technical support in workshops and laboratories.

2.8.4 Guidelines on Student Transfer and Mobility

Engineers Ireland is committed to supporting the policies of the National Qualifications Authority of Ireland in respect of facilitating access, transfer and progression for students. Programme providers should have in place procedures and regulations, consistent with maintaining academic standards, to achieve this.
PART 3:

EDUCATION STANDARD REQUIRED

FOR

REGISTRATION OF

ENGINEERING TECHNICIANS
3.1 Definition of an Engineering Technician

An Engineering Technician is competent to apply in a responsible manner proven techniques which are commonly understood by those who are expert in a branch of engineering, or those techniques specially prescribed by professional engineers. He/she works under guidance within his/her allocated responsibility.

3.2 Formation of an Engineering Technician

The formation of an Engineering Technician takes a minimum of five years and consists of two phases.

The first phase consists of studying and successfully completing an engineering certificate programme approved by Engineers Ireland as meeting the education standard required for the title Engineering Technician.

The second phase is called Initial Professional Development and generally involves the achievement of the competences necessary to apply basic principles to the solution of technical problems. This phase is described in detail in Engineers Ireland’s publication Engineering Technician – Regulations for the title of Engineering Technician.

3.3 Education Standard required for the title Engineering Technician

(a) The education standard required for the title of Engineering Technician is exemplified by a certificate in engineering approved by the Council of Engineers Ireland.

(b) Each candidate for election or transfer to the title of Engineering Technician shall possess one of the following qualifications:

(i) A National or Technician Certificate in engineering approved by the Council of Engineers Ireland;
(ii) An engineering technician qualification which the Council of Engineers Ireland, through an international agreement recognises as satisfying the education standard for the title of Engineering Technician.
(iii) Other engineering technician qualifications deemed by the Council of Engineers Ireland to satisfy the education standard for the title of Engineering Technician.

3.4 General Description of an Accredited Engineering Technician Programme

An accredited engineering technician programme which meets the education standard for the title of Engineering Technician, is one which is approved by the Executive Committee of Council on the recommendation of the Accreditation Board, as satisfying the criteria described in Part 3 of this document.

3.5 Programme Outcomes

Engineers Ireland specifies the following Programme Outcomes for engineering technician programmes aimed at satisfying the education standard for the title of Engineering Technician. Programmes submitted for accreditation must enable graduates to demonstrate:

(a) Knowledge and understanding of the basic mathematics, sciences, engineering sciences and technologies related to the particular branch of engineering.

Graduates should be able to demonstrate knowledge, understanding and the application of, inter alia;
(i) basic mathematical and scientific formulae and techniques to solve well-defined engineering problems;
(ii) basic scientific techniques and how they apply to their branch of engineering;
(iii) standard technologies and techniques used in the solution of well-defined engineering problems with particular reference to their advantages and limitations in their branch of engineering.

(b) Ability to identify, formulate and solve well-defined problems in the particular branch of engineering.

Graduates should be able to demonstrate, \textit{inter alia};

(i) knowledge and understanding of basic problem-solving techniques;
(ii) ability to apply an appropriate mathematical/analytical method to a well-defined engineering problem;
(iii) ability to use industry standard software tools for the solution of well-defined engineering problems.

(c) Ability to contribute to the design of components, systems and processes to meet specified needs.

Graduates should be able to demonstrate, \textit{inter alia};

(i) knowledge and understanding of the basics of the design process and method;
(ii) ability to contribute to the design processes within a well-defined sub-domain;
(iii) ability to use industry-standard design tools and techniques;
(iv) basic knowledge and understanding of codes of practice and industrial standards.

(d) Ability to conduct well-defined investigations to facilitate the solution of problems within the particular branch of engineering.

Graduates should be able to demonstrate, \textit{inter alia};

(i) ability to conduct experiments and collate, analyse, present and interpret basic engineering technology data sets;
(ii) ability to gather basic data from codes of practice, databases and other sources and to generate data using a range of laboratory and workshop equipment;
(iii) ability to select and apply appropriate instrumentation and techniques for fault-finding and performance testing.

(e) Understanding of the need for high ethical standards in the practice of engineering, including the responsibilities of the engineering profession towards people and the environment.

Graduates should be able to demonstrate, \textit{inter alia};

(i) knowledge and understanding of the importance of the technician’s role in society and the need for the highest ethical standards of practice;
(ii) awareness of social and environmental factors during their participation in the design process;
(iii) awareness of common environmental hazards potentially inherent in engineering systems;
(iv) knowledge of the potential health, safety and risk issues of engineering projects.

(f) Ability to work effectively as an individual and in teams, together with the capacity to undertake lifelong learning.

Graduates should be able to demonstrate, \textit{inter alia};

(i) ability to undertake Continuing Professional Development to improve their knowledge and competence;
(ii) ability to work effectively as a member of a team;
(iii) ability to consult and work with engineers in the realisation of a project;
(iv) knowledge and understanding of the respective functions of technicians, technologists and engineers and how they together constitute the engineering team.
Accreditation Criteria: Part Three

(g) Ability to communicate effectively with the engineering community and with society at large.

Graduates should be able to demonstrate, inter alia;
(i) ability to select and apply appropriate communication tools in order to create deeper understanding, and maximum impact on a given audience;
(ii) ability to describe succinctly the relevant advantages and disadvantages of their chosen engineering discipline to a lay audience;
(iii) ability to write technical reports;
(iv) ability to present a report before a panel.

3.6 Programme Area Descriptors

Engineers Ireland has determined that the study of six Programme Areas is necessary if graduates are to achieve the stated Programme Outcomes. The Programme Areas, listed below, are largely coterminous, but occasional overlap may be unavoidable.

(a) Science and Mathematics
(b) Discipline-specific Technology
(c) Software and Information Systems
(d) Design and Development
(e) Engineering Practice
(f) Social and Business Context

Programme Area descriptors outline how each Programme Area, through the Learning Outcomes of its constituent modules, facilitates the engineering graduate’s achievement of the stated Programme Outcomes.

(a) Science and Mathematics
This Programme Area should provide students with a basic understanding of the core sciences and engineering sciences, to underpin the dominant engineering technologies in their chosen field. The utility of this scientific material should be liberally demonstrated through the use of case studies and application to well-defined technical problems.

Engineering and science are strongly quantitative, as expressed through the language of mathematics. Engineering technicians need to be numerate to understand the mathematical bases of the core engineering sciences related to their discipline. As with scientific knowledge, mathematical knowledge and skills should be presented in an applied setting. Students should be given ample opportunity to apply a core of standard mathematical techniques to a range of well-defined engineering problems.

(b) Discipline-specific Technology
Technology is commonly perceived in two ways – the sum total of artefacts designed for practical purposes and the knowledge and skills associated with the structure, function, operation and application of practical artefacts. Engineering technicians have to be competent to apply the basic engineering technologies associated with their chosen discipline. Examples would include; telecommunications, power systems, control systems, manufacturing processes, highway construction and so on.

It is important, therefore, that engineering technician programmes place a primary focus on the understanding and application of core technologies. Students should be aware of the relative environmental impacts of the various technologies.

On the skills side of technology, students should be given ample opportunity to use and apply the latest software/hardware components and systems. The programme should help them develop the necessary skills in laboratories, workshops and projects. Industrial visits, placements and cooperative education schemes offer immense potential for the improvement of the students’ technological skills. Students’ knowledge of the engineering technologies will be demonstrated in laboratory reports and projects.
(c) Software and Information Systems
Software and information systems are commonly employed throughout the whole field of engineering to facilitate the solution of engineering problems and the communication of knowledge and decisions. Engineering technicians should be able to apply these tools in the field.

The mathematics underpinning these systems are often complex; for example, techniques such as structured information retrieval and filtering are in common use today. Engineering technicians should have the ability to use common software and systems tools for the solution of well-defined engineering problems.

Students should be aware of the use of computers for basic quantitative analysis and solution of common engineering problems. Students should also have experience in the application of industry-standard software to engineering problems in their chosen field. They should be shown how to apply, and where necessary, through data exchange, to integrate industry-standard software tools and information systems.

Software and information systems and the electronic encapsulation of knowledge play an important role in the manipulation of, and the communication of, engineering information. Students will therefore require skills in the use of software tools like word processors, presentation packages and spreadsheets for these purposes. They should be introduced to a wide range of computer-based data presentation techniques and should know how to choose the most appropriate one for a particular set of circumstances.

(d) Design and Development
Engineering technicians make valuable contributions to the design process. They have to implement subsets of designs led by technologists and/or Chartered Engineers. This requires, inter alia, the development of details within those designs, the execution of front-line tests to generate simple data and to validate basic assumptions used in the designs, the procurement of the necessary equipment and materials and the participation in the verification of the performance of the resultant artefacts or systems.

It is important, therefore, that engineering technician programmes give due consideration to the basic principles of design and explain the techniques specific to particular engineering products and processes. Students should learn about the various steps from idea to marketplace. Since engineering is primarily concerned with application, the programme should require students to implement simple designs through projects. This could be achieved, advantageously, on a team basis, involving, where possible, students on technology and engineering programmes.

The Engineering Technician has an important role to play in the development of products and processes. Students should therefore have opportunity to undertake basic performance testing in the laboratory, in the workshop, in particular and where possible, in the field; and further be aware of laboratory simulation. That experience, combined with case studies of similar products, should be used for the refinement, the reengineering, and the development of simple designs.

(e) Engineering Practice
Engineering practice is central to the development of the engineering technician. Programmes should explore the industrial environment where graduates are likely to apply their knowledge and skills, including markets, competitors, basic organisation structures, and be aware of the financial, commercial and environmental constraints faced by industry. The role and the career opportunities of Engineering Technicians in these industries should be clarified.

Engineering success is often the outcome of an evolutionary process based on incremental advances upon earlier experiences. It is essential, therefore, that Engineering Technicians are conversant with the core operational practices of their chosen discipline. Operational practice will include knowledge of manufacturing and basic development processes, quality assurance, project management, methods of control of engineering products and processes, awareness of environmental impacts, operational safety and the elimination of hazards in the workplace.

Students should be made aware of the practical dimension of their work. Various pedagogical approaches can facilitate the development of this awareness, and of the related skills, including case studies, industrial
placements, projects, industry speakers, laboratories, workshops and visits to industrial or commercial installations. The mechanisms and benefits of technology transfer between industry and academe should be explained.

(f) Social and Business Context
Engineering is directed to developing, providing and maintaining infrastructure, goods, systems and services for socio-economic benefit. Related education programmes need to develop an awareness of the social and commercial context of engineering. This includes an understanding of issues related to today’s multi-cultural workforce, of socio-technology and of the constraints on technological developments imposed by health and safety, the environment, codes of practice, politics, the law and financial viability and the means by which the various risks may be assessed and managed. Students should be made aware of the core methods for the assessment of quality and fitness for purpose of engineering products and systems. They should be given ample opportunity to reflect upon and discuss the ethical consequences of their decisions.

Engineering invariably involves a team approach; it is important, therefore, that students learn how to work with and for others, both within and outside their own disciplines. They should have some knowledge of team dynamics and should be capable of working within a team. Programmes should develop the student’s ability to analyse, present and communicate basic technical information to a range of audiences.

Society expects professional behaviour from the engineering profession and therefore within programmes, students should become familiar with the expectations and standards inherent in professional codes of conduct. Students should learn how to help identify their own learning needs.

The importance of students participating in identifying their own learning needs and exercising commitment to their own continuing professional development should be stressed.

3.7 Assessment of Student Performance
Examinations and other assessment instruments should be designed to evaluate the extent to which students can demonstrate achievement of the programme outcomes both throughout the programme and at its conclusion.

The quality assurance process of the programme provider should seek to ensure that adequacy of standards is achieved in all examinations.

3.8 Guidelines on Programme Structure and Resources
Engineers Ireland is primarily concerned to ensure that programmes for accreditation are designed so that students are enabled to achieve the programme outcomes specified. It does not prescribe the education standard of students entering programmes and the learning process they undertake during a programme as these are, generally, matters best dealt with by programme providers.

However, Engineers Ireland’s wide experience of accreditation has shown that certain minimum inputs, entry standards, programme duration and structure and resources, including buildings, laboratories, equipment, academic and support staff, have been required in the past if programme outcomes are to be satisfactorily achieved. Those inputs are listed in 3.8.1, 3.8.2 and 3.8.3. If providers wish to propose alternatives, they must present a detailed case indicating how programme outcomes will be met.

3.8.1 Guidelines on Entry Standards
(a) The entry standard to an engineering technician programme should be such that those holding it have a reasonable prospect of understanding the learning materials provided and of achieving the programme outcomes.
(b) Engineers Ireland accepts the following minimum entry standards for admission to accredited engineering technician programmes:

- Higher Certificate (level 6) in Engineering
  Grade D3 or higher in five Ordinary Level Leaving Certificate subjects including Mathematics and English

(c) Programme providers may propose alternative entry requirements which must satisfy the criteria in 3.8.1(a).

3.8.2 Guidelines on Programme Duration and Structure

Engineers Ireland accepts the following programme duration and structure:

- Higher Certificate (level 6) in Engineering
  Two year *ab initio* programme
  The student effort required should be such as to merit 120 ECTS credits

3.8.3 Guidelines on Resources including buildings, laboratories, equipment, academic and support staff

(a) Buildings, laboratories and equipment

The buildings, laboratories and equipment should be such as to satisfactorily support the learning process of the student in achieving the programme outcomes.

(b) Academic Staff

There should be a sufficient number of academic staff to ensure the effective delivery of the programme outcomes.

Staff teaching on engineering technician programmes should:

- Be involved with industry by secondment, consulting and ongoing industry-led research;
- Be able to demonstrate their professional competence by having undertaken work in industry/engineering consultancy and/or research and development; this is normally demonstrated through the acquisition of the Chartered Engineer title.
- Have the ability to design, develop and implement courses on an accredited engineering technician programme

(c) Support Staff

Engineering programmes require substantial inputs from non-engineering personnel in areas such as mathematics, the sciences, business management and other complementary studies. The quality of such staff is as important as that of the engineering staff and the same general standards apply.

- There should be an adequate number of technical and laboratory staff to ensure that there is a satisfactory level of technical support in workshops and laboratories.

3.8.4 Guidelines on Student Transfer and Mobility

Engineers Ireland is committed to supporting the policies of the National Qualifications Authority of Ireland in respect of facilitating access, transfer and progression for students. Programme providers should have in place procedures and regulations, consistent with maintaining academic standards, to achieve this.