# Requirements for Initial Academic Education for Engineering Technologists

## Part A: Introduction

### 1 Requirements for Graduate Membership of IPENZ

The New Zealand academic qualification recognised by IPENZ as the normal tertiary academic qualification for engineering technologists, and for those applying for entry into the membership class of Technical Member (TIPENZ), is an IPENZ-accredited Bachelor of Engineering Technology degree. These degrees are awarded after three years of full-time study or the equivalent part-time study. IPENZ accords accreditation to programmes which, after careful assessment, are deemed to meet the standards required by IPENZ in educational philosophy, staff, facilities, content, graduate competencies and other specified matters. This standard is internationally benchmarked through the Sydney Accord[2]. Graduates from such programmes are eligible, on application, for graduate membership of IPENZ (GIPENZ).

### 2 Aims and Objectives of Accreditation

The main aim of accreditation is to identify and approve those engineering technology degree programmes *that meet the standard recognised through the Sydney Accord*. These degrees need to have as a principal aim, to develop intellectual independence in graduates, and to comply with the legal definition of a degree in New Zealand (specifically, a course of advanced learning taught mainly by people who are research-active) and provide graduates with the generic attributes as outlined in Part B – the competency profile expected of graduates of Sydney-Accord-recognised qualifications.

More specifically, accreditation provides:

- public identification of programmes that have been evaluated by IPENZ, independently of the tertiary education provider offering the programme, as having met the stated criteria
- a statement of the standing that tertiary education providers can offer to prospective students
- a basis for international comparability and graduate mobility
- a statement to governments and tertiary education providers of the basic requirements of a professional engineering education and the resources reasonably required to meet these requirements
- consultative feedback on the design of new programmes and modes of delivery, and assistance in the promotion of innovation and good educational practice.

[2] IPENZ is a signatory to the Sydney Accord which is an agreement between engineering bodies in Canada, Australia, UK, Ireland, South Africa, Hong Kong-China and New Zealand that each would recognise qualifications accredited by each signatory as meeting the academic requirements for engineering technologist membership/registration of their respective engineering bodies.

## 3 Diversity of Engineering Technology Degree Programmes

IPENZ, by embracing all fields of engineering, recognises that its members work as engineers in a diverse range of work roles and industries. IPENZ education requirements, therefore, are not intended to restrict degrees to the traditional disciplines of engineering. Other disciplines and technologies may be recognised by IPENZ but this does not imply approval of either shallow or narrow specialisation.

Nationally the range of programmes offered should provide for increasing flexibility of occupational opportunity; recognise both the ever-widening range of engineering applications and the value of an engineering education in other walks of life. Some programmes may emphasise technical specialisation in a particular field; some may provide a broader technical exposure, drawing on several engineering disciplines; and some may emphasise management themes while maintaining an engineering and science core. All should develop the ability to engage with broad technical issues at an advanced level and in a real-world context.

## 4 Overview of Accreditation Criteria

There are three fundamental elements to the accreditation criteria that have been adopted by IPENZ:

Element 1: The programme and programme outcomes

1. Outcomes to be achieved
2. The curriculum
3. Admission standards
4. Assessment

Element 2: Institutional Infrastructure and Staffing

5. Academic staff
6. Technical staff
7. Laboratories
8. Independent study facilities

Element 3: Management structures and quality systems to sustain and enhance the programme and its delivery

9. Management structure
10. Institutional support
11. Advisory structures
12. Education culture
13. Quality processes

## 5 Accreditation Process

The accreditation process is defined in a separate policy document. This policy should therefore be read in conjunction with the IPENZ Accreditation Manual.

## Part B: Accreditation Criteria for Engineering Technology Degree Programmes

### Element 1: The Programme and Programme Outcomes

### 1 Programme Outcomes

**Comment**
The IPENZ accreditation process is primarily concerned with programme outcomes – the attributes demonstrated by graduates. Providers are expected to supply sufficient evidence that their engineering programmes produce graduates with the following attributes, which reflect the IPENZ Graduate Capability Profile for Engineering Technologists.

The provider is required to produce evidence that the programme produces graduates who can:

- **1.1** understand and can apply the mathematical and engineering sciences relevant to one or more practice areas within a specific engineering discipline e.g. construction, manufacturing, or roading;
- **1.2** can formulate and solve models that predict the behaviour of broadly-defined engineering systems using analytical tools appropriate to their disciplines or areas of specialisation;
- **1.3** can synthesise and demonstrate the efficacy of solutions to *broadly defined engineering problems*;
- **1.4** can recognise when further information is needed and find it by locating, searching and selecting relevant data from codes, databases and literature, and by designing and carrying out experiments;
- **1.5** understand the accepted methods of dealing with uncertainty (such as safety factors) and the limitations of the applicability of methods of design and analysis, and identify, evaluate and manage physical risks in broadly defined engineering problems;
- **1.6** function effectively in a team by working co-operatively;
- **1.7** communicate clearly, comprehending and writing effective reports and design documents, making effective oral presentations and giving clear oral instructions and understanding and acting on such instructions;
- **1.8** are aware of the role of engineers and their responsibility to society, and so can demonstrate understanding of the *general responsibilities* of an engineering technologist;
- **1.9** Understand and apply project and business management, understanding and using the appropriate project management principles and tools for broadly defined engineering problems;
- **1.10** Demonstrate competency in the practical art of engineering in their area of specialisation by interpreting the general designs of others to provide detailed, practical designs for construction/production and/or management of construction or maintenance and using the computer program in common use for broadly defined engineering problems.

**Broadly-defined engineering problems** have some or all of the following characteristics:

a. involve a variety of factors which may impose conflicting constraints

b. can be solved by application of well-proven analysis techniques
c. requires knowledge of principles and applied procedures or methodologies
d. belong to families of familiar problems which are solved in well-accepted ways
e. may be partially outside those encompassed by standards or codes of practice
f. involve several groups of stakeholders with differing and occasionally conflicting needs
g. have consequences which are important locally, but may extend more widely
h. are parts of, or systems within complex engineering problems)

**General responsibilities** of an engineering technologist include:

a. social responsibilities including ethics, health and safety and other legislation
b. cultural responsibilities including, in New Zealand, the Treaty of Waitangi
c. environmental responsibilities including the need for sustainable development and design and legislative responsibilities
d. life long learning

## 2 The Curriculum

***Comment***
*The initial tertiary education of an engineering technologist should provide an in-depth core of applied engineering knowledge and skills appropriate to an engineering discipline. Subjects should be studied formally, in an ordered programme conducted within a tertiary institution. When courses are shared between programmes the academic entry requirements, and the expected graduate competency profiles, need to be taken into account.*

### 2.1 Foundation Studies

***Comment***
*A strong grounding in mathematics, the sciences and engineering fundamentals is the foundation on which the education of an engineering technologist is based.*

Mathematics as an identifiable component should be taught in the early stages of the programme. It should be applications-based and illustrate the importance of mathematics as a tool for identifying and solving problems. Mathematics should not dominate the course but its importance should not be overlooked.

The provider is required to demonstrate that the curriculum includes:

- mathematics and sciences necessary for the study of applied engineering practice;

- a systematic introduction to the coherent body of knowledge and skills related to a particular field of engineering;
- an integrated exposure to current and emerging technologies and their applications;

## 2.2 Engineering Design

**Comment**
Engineering design is the process of devising a system, component or process to meet specified needs. It is an iterative decision-making process in which engineering knowledge and skills are applied to optimally convert resources to meet stated objectives.
Each educational programme must include a significant design component. The scope of the design experience offered by a programme should match the requirements of practice in that discipline. Design should be integrated throughout the programme and should include team efforts.

The provider is required to demonstrate that the curriculum includes most of the following features:

- engineering design, and related project work, including a range of analytical and problem solving tools and techniques appropriate to the field of engineering;
- Coverage of classical design methodology, which includes the formulation of design problem statements (objectives) and specifications, consideration of alternative solutions, synthesis and evaluation, prototyping/simulation/modelling and construction, testing;
- development of creativity;
- project management;
- consideration of realistic constraints and compliance factors

## 2.3. Professional Practice

***Comment***
Content related to professional responsibility should be integrated throughout the curriculum, and should ask students to consider the impact of engineering upon New Zealand society and upon other nations and cultures. A systems approach should be used to teach sustainable engineering concepts.

The provider is required to demonstrate that the curriculum includes:

- integrated exposure to engineering practice, including the management of engineering projects, the context in which they are applied,
- development of communication skills;

- professional responsibility, social and environmental effects, sustainability and the ethical aspects of engineering practice;
- lectures on professional ethics and conduct

### 2.4. Engineering Practice

*Comment*
The Engineering Faculty must assure that the programme curriculum devotes adequate attention to ensuring that students are exposed to current engineering practices in industry in the course of their degree. It may be integrated throughout the degree or it may be focussed on a specific work experience requirement.

The provider is required to demonstrate that:

**2.4.1** students receive first hand exposure to current engineering practices

The provider is required to demonstrate that the curriculum includes some or all of:

- use of staff with industry experience
- practical experience in an engineering environment outside the teaching establishment;
- use of guest lecturers;
- industry visits and inspections;
- industry-based projects;
- assignments based on industry practices.
- Development of appropriate workplace skills and safety practices.

## 3. Admission

*Comment*
*IPENZ has a firm commitment to the ideal of a balanced education during the formative years at secondary school, and does not favour specialisation at an early age. Adequate standards of attainment at secondary school in the disciplines of mathematics and basic sciences, and communication skills in the English language are essential components of a satisfactory preparatory education.*

The provider is required to demonstrate that:

**3.1** Different entry points to the degree programme are permitted for applicants with appropriate prior learning and/or experience.

**3.2** Students entering engineering technology degree programmes have the educational background to succeed at tertiary level in mathematics, engineering sciences, engineering subjects and supporting studies included in engineering technology degree programmes in New Zealand.

3.3 Students entering engineering technology degree programmes are competent in the English language and therefore should, on admission, provide evidence of proficiency in both written and oral English language skills. If students are admitted with English language deficiencies then special language support programmes must be provided for them.

3.4 There are appropriate support programmes for students admitted from disadvantaged or unconventional backgrounds.

3.5 There is a reasonable relationship between admission standards, student retention and graduation rates.

## 4 Assessment

**Comment:**
*Valid assessment processes are central to demonstrating consistent student attainment of the graduate attributes expected to be developed by a programme.*

The provider is required to demonstrate that:

4.1. There are specific assessment processes which measure graduate capability and performance relative to stated programme objectives, the IPENZ Graduate Profile and the knowledge and understanding appropriate to a designated specialist field of engineering.

### Element 2: Institutional Infrastructure and Staffing

***Comment***
*The quality of the environment within which a programme is taught is regarded as paramount in providing the educational experience necessary to engender independence of thought in its graduates and for satisfying the criteria defined above. In evaluating the environment, central importance will be placed upon the faculty, the support staff, the administration, the laboratories, the library, and the computing and other supporting facilities.*

## 5 Academic Staff

***Comment***
*The character of the educational experience is influenced strongly by the professional competence and outlook of the staff. In gauging the capabilities of the academic staff, IPENZ will look for evidence in such areas as qualifications (in engineering and education); engineering experience, teaching experience; scholarship; contributions to the advancement of engineering knowledge, practice and education; involvement in professional bodies, professional standing within IPENZ or other professional engineering bodies; and effective participation in professional development opportunities and programmes. Staff research and/or professional activities should include interaction with industry.*

The provider is required to demonstrate that:

5.1. the number of academic staff devoted to the programme is sufficient to cover, in terms of experience and interest, all relevant subjects

5.2. a high proportion of staff possess appropriate academic, professional and experiential backgrounds in engineering

5.3. there are sufficient full-time staff to provide the necessary levels of student interaction, student counselling and staff participation in the development, control and administration of the programme

5.4. no programme is critically dependent on one or two people

5.5. the programme leaders, relevant managers and academic staff, particularly those teaching at the advanced levels (year 2 and 3), collectively demonstrate active commitment to supporting collegial self-regulation in the New Zealand engineering profession. Evidence of this will include individual staff exhibiting a number of the following characteristics:

- show commitment to the concept of collegial self-regulation through active membership of and participation in the most relevant professional body (note: membership of international learned societies that do not maintain active local programmes would not, of itself, be counted in this context)
- present to local learned society conferences on how the staff member's research could be reflected into changed codes of practice for the NZ practising engineering community;
- develop and present technical refresher courses to NZ engineers on how new (international or national) engineering knowledge should be reflected into NZ engineering practice;
- participate in working parties developing codes of practice or standards to be applied in the New Zealand engineering community;
- undertake contract work in collaboration with industry;
- undertake expert witness work;
- participate as practice area assessors in New Zealand competence assessment processes;
- participate as panel members on New Zealand degree accreditation activities
- involvement on the committee of a branch, technical society or learned society in developing and delivering a programme of technical interest to local practising engineers
- regularly participate in professional development activities to advance their engineering knowledge and the application of this knowledge within industry
- are actively engaged in the advancement of engineering education
- maintain networks with other engineering educators, nationally and internationally, to further their knowledge and competence in the design and teaching of engineering degree programmes and courses.

5.6. programme leaders are demonstrably competent engineers in good professional standing amongst the profession as whole. Good

evidence of this would include formal recognition within the engineering profession through attainment of a competence-graded quality mark such as TIPENZ, MIPENZ, ETPract, CPEng or equivalent.

**5.7.** key academic staff teaching capstone papers are currently competent engineers in the New Zealand context as judged by peers in the wider engineering profession. Good evidence of this would include formal recognition within the engineering profession through recent success in a competence assessment e.g. for ETPract/TIPENZ or CPEng/MIPENZ.

**5.8.** academic staff numbers and teaching loads are such as to permit adequate interaction with students, support the range of learning experiences offered and to allow adequate opportunity for professional engagement outside of teaching.

NB: In evaluating this criterion benchmarking with other national and international institutions will be considered and provision of such evidence is encouraged.

## 6 Technical staff

***Comment***
*Laboratory and project work are essential components in an engineering technology degree programme.*

The provider is required to demonstrate that:

**6.1** there are sufficient, competent technical staff to ensure that laboratory experiments reflect current technologies and that student project work can include the design, construction and testing of products, processes, or systems.

## 7 Laboratories

***Comment***
*Practical laboratory based work is an essential component of an engineering technology degree.*

The provider is required to demonstrate that:

**7.1** there is sufficient, appropriately equipped laboratory space, reflecting current technologies, to support students' practical and project-based study

**7.2** health and safety policies and practices in laboratory spaces satisfy legal requirements and are in line with good practice in industry.

## 8 Independent Study Facilities

***Comment***

*Independent investigation and enquiry is an important component of degree level study and important skills for an engineering technologist.*

The provider is required to demonstrate that:

**8.1** students have appropriate independent access to laboratories to support project /research based study

**8.2** students have adequate access to sufficient library and computer resources to support their learning.

## Element 3: Management structures and quality systems to sustain and enhance the programme and its delivery

### 9 Identifiable Management structure

***Comment***
*IPENZ considers that it is essential that there is an identifiable management structure responsible for engineering education within the tertiary education provider awarding the degree. Most commonly this will take the form of an engineering school (faculty, department) – a substantial organisational entity whose prime focus and responsibility is engineering education and scholarship. Other forms of organisation may be acceptable but it is unlikely, for example, that an engineering programme would be accredited if it were taught and managed by a handful of staff, otherwise undifferentiated within (say) a Faculty of Science or a Faculty of Information Technology. It will normally be expected that the engineering school would have responsibility – subject to TEO internal approval processes – for the design, principal content and delivery of engineering programmes, for the management of associated resources, and for the appointment and professional activity of staff. If this is not the case, the tertiary education provider will need to demonstrate how sufficient engineering expertise is brought to bear on decisions in these areas.*

The provider is required to demonstrate that:

**9.1** there is an identifiable management structure in place that ensures that engineering expertise is central to decision making relating to the design, principal content and delivery of engineering programmes, for the management of associated resources, and for the appointment and professional activity of staff.

### 10 Institutional Support and Leadership

***Comment***
*Strong institutional support for a provider's engineering programmes is a key component for their long term sustainability and success.*

The provider is required to demonstrate that:

**10.1** engineering education is seen as a significant long-term component of its activity

**10.2** it has adequate arrangements for planning, development, delivery, and review of engineering programmes and for supporting the associated professional activities of staff

**10.3** it has adequate policies and mechanisms for funding its engineering programmes and facilitating the generation of funds from external sources; for attracting, appointing, retaining and rewarding well-qualified staff and providing for their ongoing professional development; and for providing and updating infrastructure and support services

**10.4** creative leadership is available to the engineering school through the appointment of highly-qualified and experienced senior staff in sufficient numbers to ensure that the art of engineering and the use of engineering judgement can be inculcated in students.

## 11 Advice from Industry

***Comment***
*Valid preparation of students for professional engineering practice requires continuing interaction with industry. An advisory group, including senior industrial representatives, should be involved at policy level and in formulating and managing overall evaluation processes rather than at the level of detailed curriculum design.*

The provider is required to demonstrate that:

**11.1** there is a formally-constituted advisory mechanism/s involving the active participation of practising engineers and leading employers of engineering graduates in:

- advising the school on trends in the industry which might impact on programme demand and curriculum content;
- defining and reviewing programme objectives
- developing and operating processes for evaluating the capabilities of graduating students
- helping academic staff maintain contact with their profession and industry;
- monitoring graduate performance in employment.

## 12 Educational Culture

***Comment***
*IPENZ will look for evidence of a dynamic, innovative and outward-looking intellectual climate in the engineering school. Staff development programmes should aim at developing teaching practice as well as discipline expertise. The curriculum and pervading culture must be gender-inclusive and take cognisance of The Treaty of Waitangi.*

The provider is required to demonstrate that:

**12.1** there is significant involvement by all teaching staff in ongoing curriculum development, improving the effectiveness of learning and teaching and promoting and supporting self-directed learning

**12.2** staff are aware of current educational thinking and best practice.

## 13 Quality Systems and Processes

*Comment*
Engineering providers are expected to have exemplary quality assurance systems, and to thereby regularly monitor and systematically improve their engineering programmes to ensure their graduates are adequately prepared to enter the engineering profession. There should be systems in place to ensure that the stated programme outcomes are consistently met and that programme objectives and programme quality are continuously reviewed and improved.

The provider is required to demonstrate that:

**13.1** there are documented processes for programme planning, curriculum development and approval, and regular curriculum and content review, involving all teaching staff

**13.2** decisions to introduce new programmes or majors, and the determination of their education objectives, must consider evidence of demand

**13.3** there is a system for the review of the admissions system that ensures that entry standards, including systems for credit recognition, are not compromising graduate quality

**13.4** there is a system for the review of assessment processes

**13.5** there are processes for securing feedback and comment from students, graduates, employers of engineers, and representatives of the community; and evidence of their systematic application to the review and continuing improvement of programme objectives, curriculum and content, and the quality of learning and teaching. Post-programme processes should include graduate employment data, alumni surveys documenting achievement, and employer surveys of longer-term performance and development

**13.6** there is substantial participation by practising engineers and leading employers of engineering graduates, in the engineering school's forward planning and in its processes for ensuring educational quality, including assessment of graduate performance. There must be evidence of real dialogue and involvement, not just token processes

**13.7** a process for comparing or benchmarking programme standards with those of other tertiary education engineering providers nationally, and preferably internationally.

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