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Professional Accreditation Handbook For Engineering Higher Diploma And Equivalent Programmes

Revised by authority of the Accreditation Committee for Higher Diploma Programmes as of June 2012

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1. FRAMEWORK FOR ACCREDITATION

1.1 Introduction

The Hong Kong Institution of Engineers (the HKIE) is the professional engineering learned society and qualifying body for Hong Kong and has a responsibility for setting and maintaining the professional and technical standards of its members.

An engineering higher diploma or equivalent programme accredited by the HKIE is an acceptable academic qualification for Associate Membership of the Institution. The HKIE's process of accrediting such programmes is called professional accreditation. (A description of professional accreditation is provided in the Appendix.) This handbook sets out the HKIE's processes, mechanisms and criteria for the professional accreditation of engineering higher diploma and equivalent programmes.

The HKIE views the accreditation of engineering higher diploma and equivalent programmes as part of a process of working with the higher education institutions on a continuous basis, to provide help, advice and support, to ensure that the quality of engineering higher diploma and equivalent programmes is high and meets the needs of the profession, employers and Hong Kong society in general.

In undertaking accreditation of engineering higher diploma and equivalent programmes, the HKIE seeks to meet the relevant international benchmarks. As the HKIE is a full signatory to the Sydney Accord, it shall ensure that the accreditation system, criteria, processes and outcomes are to meet all the requirements in the Agreement.

1.2 Accreditation by Faculty or College

Essentially, the HKIE is concerned with the standards and quality of individual engineering higher diploma and equivalent programmes. Consequently, it is the individual programme which receives accreditation. However, the process of professional accreditation involves the consideration of the appropriate Faculty / College in terms of its overall philosophy, objectives and resources, individual programmes then being considered in context. This has the advantages of taking into account the broad principles and policies of the higher education institutions for the development of engineering education, and reducing the burden on the higher education institutions and the profession of too many discrete accreditation exercises.

Although visits will normally be to departmental groupings, there may be visits to individual departments within a Faculty / College for the purpose of provisional accreditation, to consider major modifications to a programme or to monitor a programme which has been granted accreditation for less than the normal five years.

1.3 Initiation of Accreditation Exercises

The professional accreditation of engineering higher diploma and equivalent programmes in the higher education institutions is normally initiated by a higher education institution issuing an invitation to the HKIE Accreditation Committee for Higher Diploma Programmes to carry out appropriate accreditation exercises.

1.4 Consultation and Accreditation Visits

The HKIE sees its accreditation activities as a continuing process. Higher education institutions planning engineering higher diploma and equivalent programmes, or restructuring existing ones are encouraged to consult the HKIE in order to ensure that the programmes can be developed to suit the requirements of all concerned.

1.5 Provisional and Full Accreditation

The HKIE has two categories of accreditation exercise as follows:

- provisional accreditation to consider programmes which are developing; and
- full accreditation to consider new programmes after they produce their first cohort of graduates and for re-accreditation of existing programmes.

1.6 Accreditation Decisions and the Accreditation Cycle

There are three accreditation decisions (section 1.11 also refers) which the HKIE can reach, as follows:

1.6.1 Provisional Accreditation

Provisional accreditation may be granted to developing programmes, and generally the relevant accreditation exercise will be completed during the delivery of the programme for the first cohort of students. Provisional accreditation provides an indication to both the higher education institution and prospective students that the programme is well structured and has very good possibilities of receiving full accreditation but should not be construed as a commitment to the granting of full accreditation.

1.6.2 Accreditation for a Period of up to Five Years

The HKIE may grant full accreditation for the normal cycle of accreditation of five years. Alternatively, the HKIE may grant full accreditation for a term of less than five years, either to bring it in line with the accreditation cycle of other programmes or to monitor a programme early in relation to any conditions, requirements and/or concerns which may have emerged during the accreditation process.

For a newly developed programme, a full accreditation exercise is mounted, at a time agreed with the higher education institution, after the first cohort of students has graduated. Full accreditation, if granted, will be retrospective so as to apply to the first cohort of graduates.

1.6.3 Accreditation Refused or Withdrawn

If a programme is seriously at variance with the HKIE criteria (see Section 2), then accreditation can be refused or withdrawn. The HKIE considers such a decision serious and, normally, would work with the higher education institution to avoid it.

1.7 The Accreditation Panel for Engineering Higher Diploma and Equivalent Programmes

The HKIE will set up an Accreditation Panel for engineering higher diploma and equivalent programmes which comprises appropriately qualified members who will participate in accreditation exercises.

1.8 Visiting Teams

Visiting teams shall be selected from the Panel for each particular accreditation exercise. The Dean or Head of Department shall be informed of the names of the proposed chairman and members of a team; objection to a team member may be made if there is a conflict of interest. (Team members are selected on the basis that they have no professional or any other association with the higher education institution, nor members of their families attending it.)

1.8.1 Team Size and Constitution

For a single discipline exercise, the team shall normally comprise a minimum of three members including the chairman. All members shall be experienced in the discipline, or associated with it.

For exercises involving two or more programmes, which may cover more engineering disciplines, there shall be one chairman, and for each programme at least two members from, or associated with, each of the disciplines.

In general, the professional engineers constituting a team shall comprise, in approximately equal numbers, academics and non-academics.

Whenever possible, members of the Accreditation Committee for Higher Diploma Programmes shall be invited to participate in the teams.

A member of the HKIE's accreditation staff shall accompany and be a member of the team in addition to those mentioned above.

In addition, an assessor will join the visit as an observer. For details, please refer to Section 1.11.

In general, to ensure continuity and expertise, team chairmen shall have considerable previous experience in professional accreditation, and most members of the team will be expected to have knowledge and experience of professional accreditation.

1.9 Accreditation Visits

Accreditation visits are an important part of an accreditation exercise. They enable the HKIE to assess, at first hand, qualitative factors, such as facilities, intellectual environment, morale, professional attitudes and the quality of staff and students.

For programmes which are being planned by a higher education institution, the HKIE will arrange consultation visits by expert(s) as appropriate in each case. On such visits, the expert(s) shall only comment and advise on the proposed programmes and shall not commit the HKIE to granting accreditation to a programme.

It should be noted that the accreditation visits are only a part of the full accreditation exercise. There is considerable preparation prior to a visit and many post visit activities.

In general, accreditation visits will cover the review of the programme(s) concerned and the department or Faculty/College offering the programme(s). The following is an illustration of a normal coverage of a visit:

1.9.1 Visit to Consider One Programme

Such a visit will normally take at least one day and shall include:

- meetings of the team with the appropriate senior higher education institution’s staff;
- meetings with the programme leader and other academic staff;
- meetings with stakeholders (e.g. employers, members of advisory board, alumni)

- meetings with the students, graduates and support staff;

- tours of the departmental facilities, including lecture theatres, laboratories, library and computing facilities;

- inspection of examination papers, laboratory instructions and reports, project reports and other assessment materials demonstrating programme and students' outcomes; and

- private meetings of the team.

1.9.2 Visit to Consider More than One Programme

Such a visit will normally take at least one day depending on the number of programmes. The elements of this visit are similar to the 'one programme visit', and the Visiting Team may split up in reviewing a number of programmes concurrently.

1.10 Accreditation Reports

Based on a consensus of opinion, ascertained at the end of a visit, the team chairman, with the assistance of the HKIE secretariat, shall draft a formal report of the visit on the observations of the team, on whether the programme(s) under investigation conform to the HKIE Accreditation Criteria.

Notes: The following procedures had already been adopted by the Accreditation Committee for Higher Diploma Programmes in dealing with the Accreditation Report.

(i) The visiting team chairman will draft the report with the assistance of members of the team and the HKIE staff.

(ii) The draft report will be sent to the visiting team members for comment.

(iii) The comments made by the members of the visiting team will be considered by the chairman.

(iv) The modified draft report will then become the final report.

(v) The final report will be sent to the Dean and/or relevant Head(s) of Departments for comments on the factual accuracy of the report and for providing responses to the report.

(vi) The comments made and responses to the report provided by the Dean and/or Head(s) will be sent to the visiting team chairman and the assessor.

(vii) The final report, and the comments made by the Dean and/or Head(s) will be submitted to the Accreditation Committee for Higher Diploma Programmes at the decision meeting.

The HKIE maintains strict confidentiality regarding accreditation matters. It is for the higher education institution to decide how information related to this accreditation should be released and may inform HKIE accordingly.

1.11 Accreditation Decisions

In advance of the accreditation visit, the Accreditation Committee for Higher Diploma Programmes will appoint one of its members, who can join the visit as an observer, to act as an assessor. The assessor will study all the documentation and, in consultation with the visiting team chairman, make recommendations to the Accreditation Committee for Higher Diploma Programmes for an accreditation decision. The Chairman of the Accreditation Committee for Higher Diploma Programmes will initiate the discussion on the programme(s) under consideration.

The accreditation report and higher education institution's responses, and all other relevant information and correspondence are passed to the Accreditation Committee for Higher Diploma Programmes for a decision.

The representatives of the higher education institution concerned usually the Dean and/or Head of Department may attend that part of Accreditation Committee for Higher Diploma Programmes meeting devoted to the presentation of the report. Members of the team may also be present.

At the meeting, the team chairman will present the report and representatives of the higher education institution, if present, may put forward further information and answer questions of fact. The Accreditation Committee for Higher Diploma Programmes will then conduct a private meeting at which the assessor will present recommendations. After that, the Accreditation Committee for Higher Diploma Programmes may take one of the following decisions (section 1.6 refers):

a. that the programme(s) be fully accredited for a term of up to five years with or without conditions; or

b. that the developing programme(s) be granted provisional accreditation with or without conditions; or

c. that the accreditation of programme(s) be refused or terminated.

The Secretary to the Accreditation Committee for Higher Diploma Programmes will then inform the higher education institution of the decision by way of letter with a copy of the final report, in confidence, to the Vice Chancellor, President, Principal or Director, copied to the Dean or Head of Department.

1.12 Costs

Any higher education institution wishing its engineering higher diploma and equivalent programmes to be accredited by the HKIE shall pay an accreditation fee on each visit. The accreditation fee charged per visit is to be determined by the Accreditation Committee for Higher Diploma Programmes on agreement with the higher education institutions concerned.

In addition, the direct costs of each accreditation visit (travel, subsistence, accommodation) will be paid by the higher education institution concerned.

1.13 Confidentiality

All documents and other information obtained by the Accreditation Committee for Higher Diploma Programmes during the course of an exercise are kept confidential.

1.14 Appeal Procedures

In the event of a decision by the Accreditation Committee for Higher Diploma Programmes to refuse or terminate accreditation of an engineering higher diploma or equivalent programme, the higher education institution concerned has the right to appeal to the Accreditation Board to review the decision.

1.15 Publication

A full list of accredited programmes and their period of accreditation is published each year, in June, with the Annual Report of the Accreditation Committee for Higher Diploma Programmes.

2. CRITERIA FOR THE ACCREDITATION OF ENGINEERING HIGHER DIPLOMA AND EQUIVALENT PROGRAMMES

2.1 Introduction

The HKIE undertakes professional accreditation to evaluate the standard and quality of engineering higher diploma and equivalent programmes. In doing so it takes into account a number of factors about the programmes and the higher education institutions which offer them. The quality of an engineering higher diploma or equivalent programme depends on more than just the curriculum and syllabus. The quality of the graduates is an important consideration in the evaluation of an engineering higher diploma or equivalent programme. The engineering higher diploma and equivalent programmes must define outcomes that they expect of their graduates consistent with their educational objectives and the needs of the discipline; and describe the processes that are used to measure and evaluate these outcomes. In addition, the calibre of the academic staff, the entry standards, staffing levels, teaching methods, facilities, funding and methods of assessment are just some of the factors which influence the quality of the educational experience and the outcomes.

The following describes broad criteria which are used by the HKIE regarding appropriate engineering higher diploma and equivalent programmes for the profession. In setting them out, the HKIE considers it important, both in the context of educational and professional objectives, for higher education institutions to encourage an environment which can accommodate innovative educational developments and to allow for the expression of the higher education institution's individual strengths, qualities and ideals.

2.2 Standards

In undertaking accreditation, the HKIE takes note that engineering higher diploma and equivalent programmes should meet the academic requirements for the Associate Members of the HKIE and the requirements in the Sydney Accord.

2.3 One or More Programmes

The following criteria relate to one or more programmes, but for simplicity are presented in relation to one programme. Any programme proposed for accreditation must meet the following criteria.

2.4 Aims and Objectives

In its submission for accreditation of an engineering higher diploma or equivalent programme, the higher education institution should be able to express the aims, objectives and ethos of the programme(s) both in relation to the appropriate standards of engineering higher diploma and equivalent level of education and the requirements of the profession. The higher education institution should demonstrate how its programmes meet the aims and objectives, and how they can respond to future developments.

The HKIE appreciates that engineering higher diploma and equivalent programmes are dynamic entities which must evolve with technology and the changing needs of the profession and society. Consequently, the HKIE expects a higher education institution to be able to articulate such developments in terms of how the structure and rationale of its programmes can respond to change. Based on generally accepted norms, engineering higher diploma and equivalent programmes must demonstrate that their graduates have the following attributes:

(a) an ability to select and apply the knowledge, techniques, skills, and modern tools of their disciplines to broadly-defined* engineering technology activities
(b) an ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies
(c) an ability to conduct standard tests and measurements; to conduct, analyse, and interpret experiments; and to apply experimental results to improve processes
(d) an ability to design systems, components, or processes for broadly-defined* engineering technology problems appropriate to programme educational objectives
(e) an ability to function effectively in a project, as a member or leader on a technical team, in multi-disciplinary environment
(f) an ability to identify, analyse, and solve broadly-defined* engineering technology problems
(g) an ability to communicate effectively to engineers and others regarding broadly-defined* engineering technology activities
(h) an understanding of the need for and an ability to engage in self-directed continuing professional development
(i) an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity
(j) a knowledge of the impact of engineering technology solutions in a societal and global context with particular reference to the environment and sustainable development
(k) a commitment to quality, timeliness, and continuous improvement

(Broadly-defined activities are those that involve a variety of resources, that involve the use of new processes, materials, or techniques in innovative ways, and that require a knowledge of standard operating procedures.)*

The interpretation of the above graduate attributes should be made in accordance with the requirements of the Sydney Accord, including the range of problem solving and range of engineering activities, and a copy of the Sydney Accord Graduate Attributes and Professional Competencies is enclosed as Appendix in this Handbook.

2.5 Duration

The normal duration for accredited higher diploma and equivalent programmes is three years of full time equivalent study, based on entry from a satisfactory level of achievement at secondary education, or equivalent. Programmes offered via alternative implementation pathways, e.g. accelerated delivery in two years, must be substantially equivalent in terms of content and outcomes.

2.6 Part-time Engineering Higher Diploma and Equivalent Programmes

If a part-time engineering higher diploma or equivalent programme is offered, or if a student undertakes a programme on a part-time basis, all requirements of an accredited programme must be met. The standards of the graduates should not be affected by the mode of study.

2.7 Syllabus and Curriculum

The HKIE does not wish to impose any uniformity on higher education institutions in relation to curricula and syllabuses, but encourages them to develop courses, making the best use of resources, responding to academic and technological change, and recognising the needs of the students, community and profession. Nevertheless, the HKIE does require course content to be sufficient to enable engineering higher diploma and equivalent programme students to acquire, within the duration of a programme, the basic knowledge and skills necessary to enable them to practise in an effective and professional manner at the level of Associate Member of the HKIE. For definition of Higher Diploma and definition of Associate Member, please refer to the Nomenclature section of this Booklet.

The HKIE accepts that it is not in the best interest of the academic institutions and the Visiting Team to state exhaustively all essential elements and contents of a broad range of engineering courses and programmes. However, the HKIE expects the curricula for engineering higher diploma and equivalent programmes to prepare students in a broad range of areas including mathematics and computing, engineering subjects and complementary studies appropriate to the discipline. A description of each is given below to provide guidance, but is not considered to be all inclusive. The programme must ensure that its curriculum is consistent with the prescribed outcomes and objectives. The presence of each of the above elements in the curriculum is not sufficient evidence that the graduates have the outcomes that the programme desires.

2.7.1 Mathematics and Computing

The mathematics and computing contents of an engineering higher diploma or equivalent programme should provide tools for engineering subjects, should include concepts and principles, and emphasise analysis and application. Mathematics and computing may be delivered as separate topics; however, it is desirable for mathematics and computing to be delivered within the context of their application to engineering problems and within the engineering subjects of the programme. Computing is considered an essential part of the engineering education experience, and all engineering higher diploma and equivalent graduates should be computer literate, and have acquired the skills specific to their branch of engineering studies.

It is also considered that graduates of higher diploma and equivalent programmes of different engineering disciplines may require different levels and coverage of mathematical and computing skills. Within an engineering higher diploma or equivalent programme, the mathematics and computing contents should be adequate (e.g. between 5% and 15% of the programme).

2.7.2 Engineering Subjects

Within an engineering higher diploma or equivalent programme, the HKIE considers that normally about 60% of the programme should be engineering subjects.

a. Engineering Sciences

The engineering sciences have their roots in mathematics and basic sciences, but carry knowledge further towards creative application. In name they may include such (courses) subjects as mechanics of solids, fluid mechanics, thermodynamics, electrical and electronic circuits, materials science, soil mechanics, aerodynamics, control systems, transport, and so on depending on the discipline.

In an engineering higher diploma or equivalent programme, the HKIE expects a higher education institution to provide engineering courses for the appropriate discipline, and others which provide an appreciation of related disciplines, to support the educational objectives and outcomes desired.

b. Engineering Design

The HKIE believes the importance of design is such that a separate topic on it should be established. However, it is accepted that the applied nature of this activity is relevant to almost every engineering endeavour and that its delivery could be within the engineering science courses in a programme. The establishment of it as a separate topic can be used to demonstrate that it is a creative, iterative and often open-ended process and to provide for discussion of general design techniques and philosophy, as well as the financial, quality, safety, ethical and environmental implications.

c. Laboratory and Field Work

Courses must be supported by laboratory work, well co-ordinated with the lecture material and supported with relevant up-to-date equipment. The HKIE believes that graduates of engineering higher diploma and equivalent prorammes should be skilled in laboratory work and fieldwork as appropriate to the discipline and be familiar with some of the instruments and testing equipment common to that discipline.

Residential field courses in subjects such as surveying and geology are considered important where these subjects are an integral part of the programme.

d. Project

The HKIE believes that project work is an important means of introducing a professional approach to engineering studies. For this reason, the use of projects as a vehicle for the integration of subject areas is strongly recommended throughout the course. The programme should include challenging project work. Normally, students should be individually assessed. The final year project should pull together the many strands of the programme, particularly addressing design, synthesis, application and creativity.

e. Practical Training

The benefits of practical experience obtained during an engineering higher diploma or equivalent programme are recognised. It is recommended that students aggregate significant, relevant practical training or employment. The higher education institutions should encourage this activity.

f. Health, Safety and the Environment

Appropriate exposure to health, safety and environmental considerations for workers and the general public should be integral and demonstrable components of programmes.

2.7.3 Complementary Studies

Studies which provide the students with an appreciation of wider issues to enable them to operate responsibly in society should be fully integrated within the programme. Such studies may include management, economics, law, finance, a foreign language, and so on. The following elements should be included in the curriculum.

a. Communications

It is essential for graduates of engineering higher diploma and equivalent programmes to have good communication skills. Engineering higher diploma and equivalent programmes should contain instruction in the art and practice of communication by the spoken and written word, and where appropriate by drawing and sketching. It is desirable that oral presentations are included in the assessment. It is important that graduates of engineering higher diploma and equivalent programmes should have an appropriate level of proficiency in English and Chinese.

b. Engineering Profession

It is considered that students should be introduced to the role of practising Associate Members of the HKIE, their social and ethical responsibilities towards the profession, colleagues, employers, clients and the public, and the impact of technology on society. Furthermore, they should be made aware of the role of the engineering institutions.

They should also be encouraged to become student members of the HKIE and to take part in its activities.

2.8 Academic Staff

Important factors in determining the standard of an engineering higher diploma or equivalent programme are the experience, quality and commitment of the teaching staff. The programme must demonstrate that it has academic staff consistent with the delivery of the educational objectives and outcomes desired. The qualifications and number of staff is a necessary, but not sufficient criteria in establishing the appropriateness of the teaching cadre.

Engineering staff should have effective control of engineering higher diploma and equivalent programmes even if some parts of the programmes may be supported by non-engineering staff.

2.9 Resources

Engineering higher diploma and equivalent programmes rely on an adequate provision of support staff, administration, laboratories, information services, computing facilities, finance and other resources and there should be an adequate provision of:

2.9.1 Support Staff

There should be sufficient technicians and workshop staff to ensure the smooth and safe management of laboratories, maintenance of equipment and general support.

Administrative and secretariat staff should be sufficient to aid the academic staff.

2.9.2 Accommodation and Equipment

There must be adequate provision of lecture rooms, laboratories, workshops, drawing offices and private study areas to support the programme of lectures, tutorials and practical work. Laboratories should be well equipped with adequate and modern equipment and should provide a safe working environment for the students.

2.9.3 Computing Facilities

Computing facilities should be consistent with the aim of using computers as part of the engineering education experience. These facilities must be appropriate for engineering applications such as modelling, simulation, computer aided design and laboratory work.

Students should have easy and adequate access to such facilities.

2.9.4 Information Services

The higher education institution should be able to provide adequate resources for reference and information making use of conventional and latest methods and facilities, including books, journals, tapes, films, and internet.

Regarding conventional library facilities, these should provide a range and variety of technical and non-technical books, and a comprehensive range of journals covering relevant engineering disciplines. The inter-library loan system should be available to all students, together with abstract and literature search facilities for project work. Students should have easy and adequate access to these facilities.

2.9.5 Finance

This should be adequate to ensure the smooth operation of a programme and the provision and maintenance of laboratories, computers, libraries and other support facilities as well as for the development of the staff, programme, courses and the upgrading of equipment.

2.10 Assessment

Assessment of student performance should demonstrate the effectiveness of the learning process in achieving the programme outcomes.

The HKIE believes that an independent quality assurance system such as the independent external examiner system or equivalent, is essential to maintain the academic standards of programmes.

2.11 Entry Levels

The HKIE does not prescribe minimum qualifications for entry to engineering higher diploma and equivalent programmes, but it does expect that the selection criteria are consistent with the majority of students being able to complete the programme at the expected standard. While a broadening of subjects studied prior to an engineering higher diploma or equivalent programme can be beneficial, for entry to engineering higher diploma and equivalent programmes the HKIE considers that students should have appropriate preparations in the relevant subjects in the Hong Kong Diploma of Secondary Education Examination or equivalent.

The programme must demonstrate that the selection procedures in place are consistent with the selection criteria and the expected outcomes.

2.12 Development

The HKIE believes it is incumbent on an academic institution to be sensitive to the requirements of society and the profession, and consequently, to develop programmes to respond to local and international requirements and to provide opportunities for staff to develop their skills so that they can deliver programmes meeting local and international professional and academic standards. In order to do this, the HKIE believes that higher education institutions have a responsibility to liaise with the engineering profession and industry in relation to engineering higher diploma and equivalent programmes, and their development.

2.13 Programme Amendments

It is expected that from time to time there will be evolutionary changes to a programme within the period of its accreditation. Any modification to a programme should maintain the spirit of the programme as accredited and may include such changes as:

- a change in the title of the programme;
- a change in the length of the programme;
- the addition/deletion of options and/or streams;
- a significant reduction in the provision of resources for the programme.

The higher education institution should inform the HKIE of major curriculum changes. The Accreditation Committee for Higher Diploma Programmes may then consider any subsequent actions including initiation of a visit or request of a written report.

3. ACCREDITATION SUBMISSIONS

When preparing a submission for professional accreditation, the higher education institution is advised to consider the criteria in section 2 carefully, and to consult the HKIE as appropriate.

3.1 Provisional or Full Accreditation

The information requested in the following sections relates to both provisional and full accreditation submission.

For the provisional accreditation of developing programmes, the process should normally commence at least six months before the first cohort of students has reached the half way stage of the programme, at which time the responsible higher education institution should provide the preliminary details (section 3.2).

For the full accreditation of existing programmes, the responsible higher education institution should submit the preliminary details no later than six months before the expiry of the current approval.

For the full accreditation of developing programmes, the exercise may commence at a date, mutually acceptable to the HKIE and the higher education institution, after the first cohort of graduates has emerged. The preliminary details should be submitted no later than six months before the visit.

In both cases, the full information requested (section 3.3) should be submitted at least six weeks before the date of any visit. If, as a result of considering the submission, further information is required, the chairman of the HKIE Accreditation Committee for Higher Diploma Programmes, in consultation with the chairman of the visiting team and the higher education institution, may arrange to delay the timing of any visit or, in exceptional circumstances, the cancellation of the exercise.

3.2 Preliminary Details

A higher education institution seeking accreditation of a programme(s) is required to submit the following preliminary details:

1. title of the Faculty/College or Department;

2. names, qualifications and date of appointments of Dean/Academic Director and Heads of Department;

3. title of the programme(s);

4. name of programme leader;

5. accreditation sought (provisional or full);

6. brief resume(s), 100 words maximum, about the programme(s) submitted;

7. provisional dates for the visit.

Upon receiving the preliminary details, the HKIE will contact the higher education institution seeking further information and/or providing further directions related to the full submission.

3.3 Full Information

Submission of full information for accreditation should be made by completing the HKIE submission format. Softcopies of the submission format are available from HKIE upon request. Copies of the completed submission documents are to be provided at least six weeks before the date of a visit. The submission format is set out as follows:

Part 1: General information related to the higher education institution

Part 2: General information related to the department

Part 3: Information related to the engineering higher diploma or equivalent programme – general

Part 4: Information related to the engineering higher diploma or equivalent programme – criteria specific

3.4 Information to be Available During the Visit

The following materials and representative samples of student work that reveal the spectrum of educational outcomes are to be made available during the accreditation visit:

1. Evidence of process used to identify educational objectives;

2. Evidence of process used to identify programme outcomes;

3. Evidence regarding students' achievement of the intended learning outcomes at various stages of the programme. This may include students' work, e.g. examination papers, marked examination scripts, examples of final year projects, laboratory reports, external evaluation, etc.;

4. Evidence of process used to improve the educational system of the programme including changes that have been made and/or proposed.

APPENDIX

NOMENCLATURE

Academic Accreditation
Evaluation or assessment to determine whether the academic standards of an institution of higher education are comparable with internationally recognised standards. It includes course validation, course revalidation, institutional review and institutional accreditation.

Professional Accreditation
Evaluation of the academic standards of a degree or sub-degree programme and consideration of the appropriateness of the education component of that degree or sub-degree programme for professional practice.

The Accreditation Panel for Engineering Higher Diploma and Equivalent Programmes
Those Members of the Institution who are appointed to carry out professional accreditation visits on behalf of the HKIE.

The Accreditation Exercise
The complete professional accreditation process.

The Accreditation Visit
A visit to an academic institution as an integral part of the professional accreditation exercise.

The Visiting Team
Members of the Accreditation Panel selected to carry out an accreditation exercise.

Programme
Refers to the complete curriculum of an engineering higher diploma or equivalent programme, comprising courses/modules/credit units, assignments, workshops, projects and so on.

Course
Refers to a specific taught part of an engineering higher diploma or equivalent programme (course is sometimes used to describe a whole engineering higher diploma or equivalent programme, where that programme has a fixed curriculum). Courses are sometimes referred to as subjects, modules or credit units.

Definition of Higher Diploma

Higher Diploma is an award, in which the course structure and curriculum provide a self-contained body of knowledge and skills, designed to meet the needs of industry at Technician Engineers level***** in a specific engineering discipline.

A technician engineer***** is one who can apply in a responsible manner proven techniques which are commonly understood to be appropriate by those who are expert in the specific engineering discipline, and any other techniques specially prescribed by his/her professional engineer supervisors.

A technician engineer***** requires an education and training sufficient to enable him/her to understand the reasons for and purpose of the operations for which he/she is responsible.

Associate Members of the HKIE

A definition used by the Conference of Engineering Societies of Western Europe and the United States, was adopted by the HKIE for the class of Associate Member:

"An Associate Member is one who can 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.

"Under general professional engineering direction, or following established engineering techniques, he is capable of carrying out duties which may be found among the list of examples set out below.

"In carrying out many of these duties, competent supervision of the work of skilled craftsman will be necessary. The techniques employed demand acquired experience and knowledge of a particular branch of engineering, combined with the ability to work out the details of a task in the light of well-established practice.

"An Associate Member requires an education and training sufficient to enable him to understand the reasons for and purpose of the operations for which he is responsible.

"The following duties are typical of those carried out by Associate Members under the conditions referred to above.

"Working on design and development of engineering plant and structures: erecting and commissioning of engineering equipment and structure; engineering drawing; estimating, inspecting and testing engineering construction and equipment; use of surveying instruments; operating, maintaining and repairing engineering machinery, plant and engineering services and locating defects therein; activities connected with research and development, testing of materials and components and sales engineering, servicing equipment and advising consumers."

Note: * The programmes accredited by the HKIE under this criteria are meeting the academic formation for "engineering technologist" under the Sydney Accord while in Hong Kong, they are commonly known as "technician engineer".

INTERNATIONAL ENGINEERING ALLIANCE

Constituent Agreements

Washington Accord	International Professional Engineers Agreement
Sydney Accord	International Engineering Technologists Agreement
Dublin Accord	APEC Engineer Agreement

Graduate Attributes and Professional Competencies

Version 3: 21 June 2013

This document is available through the IEA website: http://www.ieagreements.org.

Executive Summary

Several accrediting bodies for engineering qualifications have developed outcomes-based criteria for evaluating programmes. Similarly, a number of engineering regulatory bodies have developed or are in the process of developing competency-based standards for registration. Educational and professional accords for mutual recognition of qualifications and registration have developed statements of graduate attributes and professional competency profiles. This document presents the background to these developments, their purpose and the methodology and limitations of the statements. After defining general range statements that allow the competencies of the different categories to be distinguished, the paper presents the graduate attributes and professional competency profiles for three professional tracks: engineer, engineering technologist and engineering technician.

1 Introduction

Engineering is an activity that is essential to meeting the needs of people, economic development and the provision of services to society. Engineering involves the purposeful application of mathematical and natural sciences and a body of engineering knowledge, technology and techniques. Engineering seeks to produce solutions whose effects are predicted to the greatest degree possible in often uncertain contexts. While bringing benefits, engineering activity has potential adverse consequences. Engineering therefore must be carried out responsibly and ethically, use available resources efficiently, be economic, safeguard health and safety, be environmentally sound and sustainable and generally manage risks throughout the entire lifecycle of a system.

Typical engineering activity requires several roles including those of the engineer, engineering technologist and engineering technician, recognized as professional registration categories in many jurisdictions[1]. These roles are defined by their distinctive competencies and their level of responsibility to the public. There is a degree of overlap between roles. The distinctive competencies, together with their educational underpinnings, are defined in sections 4 to 6 of this document.

The development of an engineering professional in any of the categories is an ongoing process with important identified stages. The first stage is the attainment of an *accredited educational qualification*, the graduate stage. The fundamental purpose of *engineering education* is to build a

[1] The terminology used in this document uses the term *engineering* as an activity in a broad sense and *engineer* as shorthand for the various types of professional and chartered engineer. It is recognized that *engineers*, *engineering technologists* and *engineering technicians* may have specific titles or designations and differing legal empowerment or restrictions within individual jurisdictions.

knowledge base and attributes to enable the graduate to continue learning and to proceed to formative development that will develop the competencies required for independent practice. The second stage, following after a period of formative development, is *professional registration*. The fundamental purpose of formative development is to build on the educational base to develop the competencies required for independent practice in which the graduate works with engineering practitioners and progresses from an assisting role to taking more individual and team responsibility until competence can be demonstrated at the level required for registration. Once registered, the practitioner must maintain and expand competence.

For engineers and engineering technologists, a third milestone is to qualify for the *international register* held by the various jurisdictions. In addition, engineers, technologists and technicians are expected to maintain and enhance competency throughout their working lives.

Several international accords provide for recognition of graduates of accredited programmes of each signatory by the remaining signatories. The Washington Accord (WA) provides for mutual recognition of programmes accredited for the engineer track. The Sydney Accord (SA) establishes mutual recognition of accredited qualifications for engineering technologist. The Dublin Accord (DA) provides for mutual recognition of accredited qualifications for engineering technicians. These accords are based on the principle of substantial equivalence rather than exact correspondence of content and outcomes. This document records the signatories' consensus on the attributes of graduates for each accord.

Similarly, the International Professional Engineers Agreement[2] (IPEA) and the International Engineering Technologists Agreement[3] (IETA) provide mechanisms to support the recognition of a professional registered in one signatory jurisdiction obtaining recognition in another. The signatories have formulated consensus competency profiles for the registration and these are recorded in this document. While no competence forum currently exists for technicians, competency statements were also formulated for completeness and to facilitate any future development.

Section 2 give the background to the graduate attributes presented in section 5. Section 3 provides background to the professional competency profiles presented in section 6. General range statements are presented in section 4. The graduate attributes are presented in section 5 while the professional competency profiles are defined in section 6. Appendix A defines terms used in this document. Appendix B sketches the origin and development history of the graduate attributes and professional competency profiles.

2 Graduate Attributes

2.1 Purpose of Graduate Attributes

Graduate attributes form a set of individually assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practise at the appropriate level. The graduate attributes are exemplars of the attributes expected of graduate from an accredited programme. Graduate attributes are clear, succinct statements of the expected capability, qualified if necessary by a range indication appropriate to the type of programme.

The graduate attributes are intended to assist Signatories and Provisional Members to develop outcomes-based accreditation criteria for use by their respective jurisdictions. Also, the graduate attributes guide bodies developing their accreditation systems with a view to seeking signatory status.

Graduate attributes are defined for educational qualifications in the engineer, engineering technologist and engineering technician tracks. The graduate attributes serve to identify the distinctive

[2] Formerly the Engineers Mobility Forum (EMF).
[3] Formerly the Engineering Technologists Mobility Forum (ETMF)

characteristics as well as areas of commonality between the expected outcomes of the different types of programmes.

2.2 Limitation of Graduate Attributes

Each signatory defines the standards for the relevant track (engineer, engineering technologist or engineering technician) against which engineering educational programmes are accredited. Each educational level accord is based on the principle of *substantial equivalence*, that is, programmes are not expected to have identical outcomes and content but rather produce graduates who could enter employment and be fit to undertake a programme of training and experiential learning leading to professional competence and registration. The graduate attributes provide a point of reference for bodies to describe the outcomes of substantially equivalent qualification. The graduate attributes do not, in themselves, constitute an "international standard" for accredited qualifications but provide a widely accepted common reference for bodies to describe the outcomes of substantially equivalent qualifications.

The term graduate does not imply a particular type of qualification but rather the exit level of the qualification, be it a degree or diploma.

2.3 Graduate Attributes and the Quality of Programmes

The Washington, Sydney and Dublin Accords "recognise the substantial equivalence of … programmes satisfying the academic requirements for practice …" for engineers, engineering technologists and engineering technicians respectively. The Graduate Attributes are assessable outcomes, supported by level statements, developed by the signatories that give confidence that the educational objectives of programmes are being achieved. The quality of a programme depends not only on the stated objectives and attributes to be assessed but also on the programme design, resources committed to the programme, the teaching and learning process and assessment of students, including confirmation that the graduate attributes are satisfied. The Accords therefore base the judgement of the substantial equivalence of programmes accredited by signatories on both the Graduate Attributes and the best practice indicators for evaluating programme quality listed in the Accords' Rules and Procedures[4].

2.4 Scope and Organisation of Graduate Attributes

The graduate attributes are organized using twelve headings shown in section 5.2. Each heading identifies the differentiating characteristic that allows the distinctive roles of engineers, technologists and technicians to be distinguished by range information.

For each attribute, statements are formulated for engineer, engineering technologist and engineering technician using a common stem, with ranging information appropriate to each educational track defined in sections 4.1 and 5.1. For example, for the **Knowledge of Engineering Sciences** attribute:

Common Stem: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization …

- **Engineer Range:** … as described in the engineer knowledge profile to the solution of complex engineering problems.
- **Engineering Technologist Range:** … as described in the engineering technologist knowledge profile to defined and applied engineering procedures, processes, systems or methodologies.
- **Engineering Technician Range:** … as described in the engineering technician knowledge profile to wide practical procedures and practices.

[4] Accord Rules and Procedures. June 2012, section C.4.8. Available at www.ieagreements.org.

The resulting statements are shown below for this example:

… for Washington Accord Graduate	… for Sydney Accord Graduate	… for Dublin Accord Graduate
Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization as specified in WK1-WK4 respectively to the solution of complex engineering problems.	Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization as specified in SK1-SK4 respectively to defined and applied engineering procedures, processes, systems or methodologies.	Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization as specified in DK1-DK4 respectively to wide practical procedures and practices.

The range qualifier in several attribute statements uses the notions of *complex engineering problems*, *broadly-defined engineering problems* and *well-defined engineering problems*. These shorthand level descriptors are defined in section 4.1.

The attributes are chosen to be universally applicable and reflect acceptable minimum standards and be capable of objective measurement. While all attributes are important, individual attributes are not necessarily of equal weight. Attributes are selected that are expected to be valid for extended periods and changed infrequently only after considerable debate. Attributes may depend on information external to this document, for example generally accepted principles of ethical conduct.

The full set of graduate attribute definitions is given in section 5.

2.5 Contextual Interpretation

The graduate attributes are stated generically and are applicable to all engineering disciplines. In interpreting the statements within a disciplinary context, individual statements may be amplified and given particular emphasis but must not be altered in substance or individual elements ignored.

2.6 Best Practice in Application of Graduate Attributes

The attributes of Accord programmes are defined as a *knowledge profile*, an indicated volume of learning and the attributes against which graduates must be able to perform. The requirements are stated without reference to the design of programmes that would achieve the requirements. Providers therefore have freedom to design programmes with different detailed structure, learning pathways and modes of delivery. Evaluation of individual programmes is the concern of national accreditation systems.

3 Professional Competency Profiles

3.1 Purpose of Professional Competency Profiles

A professionally or occupationally *competent person* has the attributes necessary to perform the activities within the profession or occupation to the standards expected in independent employment or practice. The *professional competency profiles* for each professional category record the elements of competency necessary for competent performance that the professional is expected to be able to demonstrate in a holistic way at the stage of attaining registration.

Professional competence can be described using a set of attributes corresponding largely to the graduate attributes, but with different emphases. For example, at the professional level, the ability to take responsibility in a real-life situation is essential. Unlike the graduate attributes, professional competence is more than a set of attributes that can be demonstrated individually. Rather, competence must be assessed holistically.

3.2 Scope and Organisation of Professional Competency Profiles

The professional competency profiles are written for each of the three categories: engineer, engineering technologist and engineering technician at the point of registration[5]. Each profile consists of thirteen elements. Individual elements are formulated around a differentiating characteristic using a stem and modifier, similarly to the method used for the graduate attributes described in section 2.3.

The stems are common to all three categories and the range modifiers allow distinctions and commonalities between categories to be identified. Like their counterparts in the graduate attributes, the range statements use the notions of complex engineering problems, broadly-defined engineering problems and well-defined engineering problems defined in section 4.1. At the professional level, a classification of engineering activities is used to define ranges and to distinguish between categories. Engineering activities are classified as *complex*, *broadly-defined* or *well-defined*. These shorthand level descriptors are defined in section 4.2.

3.3 Limitations of Professional Competency Profile

As in the case of the graduate attributes, the professional competency profiles are not prescriptive in detail but rather reflect the essential elements that would be present in competency standards.

The professional competency profiles do not specify performance indicators or how the above items should be interpreted in assessing evidence of competence from different areas of practice or for different types of work. Section 3.4 examines contextual interpretation.

Each jurisdiction may define *performance indicators*, that is actions on the part of the candidate that demonstrate competence. For example, a design competency may be evidenced by the following performances:

1: Identify and analyse design/ planning requirement and draw up detailed requirements specification
2: Synthesise a range of potential solutions to problem or approaches to project execution
3: Evaluate the potential approaches against requirements and impacts outside requirements
4: Fully develop design of selected option
5: Produce design documentation for implementation

3.4 Contextual Interpretation

Demonstration of competence may take place in different areas of practice and different types of work. Competence statements are therefore discipline-independent. Competence statements accommodate different types of work, for example design, research and development and engineering management by using the broad phases in the cycle of engineering activity: problem analysis, synthesis, implementation, operation and evaluation, together the management attributes needed. The competence statements include the personal attributes needed for competent performance irrespective of specific local requirements: communication, ethical practice, judgement, taking responsibility and the protection of society.

The professional competency profiles are stated generically and are applicable to all engineering disciplines. The application of a competency profile may require amplification in different regulatory, disciplinary, occupational or environmental contexts. In interpreting the statements within a particular context, individual statements may be amplified and given particular emphasis but must not be altered in substance or ignored.

3.5 Mobility between Professional Categories

The graduate attributes and professional competency for each of three categories of engineering practitioner define the benchmark route or vertical progression in each category. This document does

[5] Requirements for the IEPA and IETA International Registers call for enhanced competency and responsibility.

not address the movement of individuals between categories, a process that usually required additional education, training and experience. The graduate attributes and professional competencies, through their definitions of level of demand, knowledge profile and outcomes to be achieved, allow a person planning such a change to gauge the further learning and experience that will be required. The education and registration requirements of the jurisdiction should be examined for specific requirements.

4 Common Range and Contextual Definitions

4.1 Range of Problem Solving

References to the Knowledge Profile are shown thus: (WK3, WK4 ...)

In the context of both Graduate Attributes and Professional Competencies:			
Attribute	***Complex Engineering Problems*** have characteristic WP1 and some or all of WP2 to WP7:	***Broadly-defined Engineering Problems*** **have characteristic SP1 and some or all of SP2 to SP7:**	***Well-defined Engineering Problems*** have characteristic DP1 and some or all of DP2 to DP7:
Depth of Knowledge Required	**WP1:** Cannot be resolved without in-depth engineering knowledge at the level of one or more of WK3, WK4, WK5, WK6 or WK8 which allows a fundamentals-based, first principles analytical approach	**SP1:** Cannot be resolved without engineering knowledge at the level of one or more of SK 4, SK5, and SK6 supported by SK3 with a strong emphasis on the application of developed technology	**DP1:** Cannot be resolved without extensive practical knowledge as reflected in DK5 and DK6 supported by theoretical knowledge defined in DK3 and DK4
Range of conflicting requirements	**WP2:** Involve wide-ranging or conflicting technical, engineering and other issues	**SP2:** Involve a variety of factors which may impose conflicting constraints	**DP2:** Involve several issues, but with few of these exerting conflicting constraints
Depth of analysis required	**WP3:** Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models	**SP3:** Can be solved by application of well-proven analysis techniques	**DP3:** Can be solved in standardised ways
Familiarity of issues	**WP4:** Involve infrequently encountered issues	**SP4:** Belong to families of familiar problems which are solved in well-accepted ways	**DP4:** Are frequently encountered and thus familiar to most practitioners in the practice area
Extent of applicable codes	**WP5:** Are outside problems encompassed by standards and codes of practice for professional engineering	**SP5:** May be partially outside those encompassed by standards or codes of practice	**DP5:** Are encompassed by standards and/or documented codes of practice
Extent of stakeholder involvement and conflicting requirements	**WP6:** Involve diverse groups of stakeholders with widely varying needs	**SP6:** Involve several groups of stakeholders with differing and occasionally conflicting needs	**DP6:** Involve a limited range of stakeholders with differing needs
Interdependence	**WP 7:** Are high level problems including many component parts or sub-problems	**SP7:** Are parts of, or systems within complex engineering problems	**DP7:** Are discrete components of engineering systems
In addition, in the context of the Professional Competencies			
Consequences	**EP1:** Have significant consequences in a range of contexts	**TP1:**Have consequences which are important locally, but may extend more widely	**NP1:** Have consequences which are locally important and not far-reaching
Judgement	**EP2:** Require judgement in decision making	**TP2:** Require judgement in decision making	

4.2 Range of Engineering Activities

Attribute	Complex Activities	Broadly-defined Activities	Well-defined Activities
Preamble	**Complex activities** means *(engineering)* activities or projects that have some or all of the following characteristics:	**Broadly defined activities** means *(engineering)* activities or projects that have some or all of the following characteristics:	**Well-defined activities** means *(engineering)* activities or projects that have some or all of the following characteristics:
Range of resources	**EA1:** Involve the use of diverse resources (and for this purpose resources includes people, money, equipment, materials, information and technologies)	**TA1:** Involve a variety of resources (and for this purposes resources includes people, money, equipment, materials, information and technologies)	**NA1:** Involve a limited range of resources (and for this purpose resources includes people, money, equipment, materials, information and technologies)
Level of interactions	**EA2:** Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues,	**TA2:** Require resolution of occasional interactions between technical, engineering and other issues, of which few are conflicting	**NA2:** Require resolution of interactions between limited technical and engineering issues with little or no impact of wider issues
Innovation	**EA3:** Involve creative use of engineering principles and research-based knowledge in novel ways.	**TA3:** Involve the use of new materials, techniques or processes in non-standard ways	**NA3:** Involve the use of existing materials techniques, or processes in modified or new ways
Consequences to society and the environment	**EA4:** Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation	**TA4:** Have reasonably predictable consequences that are most important locally, but may extend more widely	**NA4:** Have consequences that are locally important and not far-reaching
Familiarity	**EA5:** Can extend beyond previous experiences by applying principles-based approaches	**TA5:** Require a knowledge of normal operating procedures and processes	**NA5:** Require a knowledge of practical procedures and practices for widely-applied operations and processes

5 Accord programme profiles

The following tables provides profiles of graduates of three types of tertiary education engineering programmes. See section 4 for definitions of complex engineering problems, broadly-defined engineering problems and well-defined engineering problems.

5.1 Knowledge profile

A Washington Accord programme provides:	**A Sydney Accord programme** provides:	**A Dublin Accord programme** provides:
WK1: A systematic, theory-based understanding of the **natural sciences** applicable to the discipline	**SK1:** A systematic, theory-based understanding of the **natural sciences** applicable to the sub-discipline	**DK1:** A descriptive, formula-based understanding of the **natural sciences** applicable in a sub-discipline
WK2: Conceptually-based **mathematics**, numerical analysis, statistics and formal aspects of computer and information science to support analysis and modelling applicable to the discipline	**SK2:** Conceptually-based **mathematics**, numerical analysis, statistics and aspects of computer and information science to support analysis and use of models applicable to the sub-discipline	**DK2:** Procedural **mathematics**, numerical analysis, statistics applicable in a sub-discipline
WK3: A systematic, theory-based formulation of **engineering fundamentals** required in the engineering discipline	**SK3:** A systematic , theory-based formulation of **engineering fundamentals** required in an accepted sub-discipline	**DK3:** A coherent procedural formulation of **engineering fundamentals** required in an accepted sub-discipline
WK4: Engineering **specialist knowledge** that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.	**SK4:** Engineering **specialist knowledge** that provides theoretical frameworks and bodies of knowledge for an accepted sub-discipline	**DK4:** Engineering **specialist knowledge** that provides the body of knowledge for an accepted sub-discipline
WK5: Knowledge that supports **engineering design** in a practice area	**SK5:** Knowledge that supports **engineering design** using the technologies of a practice area	**DK5:** Knowledge that supports **engineering design** based on the techniques and procedures of a practice area
WK6: Knowledge of **engineering practice** (technology) in the practice areas in the engineering discipline	**SK6:** Knowledge of **engineering technologies** applicable in the sub-discipline	**DK6:** Codified **practical engineering knowledge** in recognised practice area.
WK7: Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the professional responsibility of an engineer to public safety; the impacts of engineering activity: economic, social, cultural, environmental and sustainability	**SK7: Comprehension of** the role of technology in society and identified issues in applying engineering technology: ethics and impacts: economic, social, environmental and sustainability	**DK7: Knowledge** of issues and approaches in engineering technician practice: ethics, financial, cultural, environmental and sustainability impacts
WK8: Engagement with selected knowledge in the **research literature** of the discipline	**SK8:** Engagement with the **technological literature** of the discipline	
A programme that builds this type of knowledge and develops the attributes listed below is typically achieved in 4 to 5 years of study, depending on the level of students at entry.	A programme that builds this type of knowledge and develops the attributes listed below is typically achieved in 3 to 4 years of study, depending on the level of students at entry.	A programme that builds this type of knowledge and develops the attributes listed below is typically achieved in 2 to 3 years of study, depending on the level of students at entry.

5.2 Graduate Attribute Profiles

References to the Knowledge Profile are shown thus: (WK1 to WK4)

Differentiating Characteristic	... for Washington Accord Graduate	... for Sydney Accord Graduate	... for Dublin Accord Graduate
Engineering Knowledge:	**WA1:** Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to the solution of complex engineering problems.	**SA1:** Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in SK1 to SK4 respectively to defined and applied engineering procedures, processes, systems or methodologies.	**DA1:** Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in DK1 to DK4 respectively to wide practical procedures and practices.
Problem Analysis Complexity of analysis	**WA2:** Identify, formulate, research literature and analyse *complex* engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. (WK1 to WK4)	**SA2:** Identify, formulate, research literature and analyse *broadly-defined* engineering problems reaching substantiated conclusions using analytical tools appropriate to the discipline or area of specialisation. (SK1 to SK4)	**DA2:** Identify and analyse *well-defined* engineering problems reaching substantiated conclusions using codified methods of analysis specific to their field of activity. (DK1 to DK4)
Design/ development of solutions: Breadth and uniqueness of engineering problems i.e. the extent to which problems are original and to which solutions have previously been identified or codified	**WA3:** Design solutions for *complex* engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. (WK5)	**SA3:** Design solutions for *broadly- defined* engineering technology problems and *contribute to* the design of systems, components or processes to meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. (SK5)	**DA3:** Design solutions for *well-defined* technical problems and *assist with* the design of systems, components or processes to meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. (DK5)
Investigation: Breadth and depth of investigation and experimentation	**WA4:** Conduct investigations of *complex* problems using research-based knowledge (WK8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.	**SA4:** Conduct investigations of *broadly-defined* problems; locate, search and select relevant data from codes, data bases and literature (SK8), design and conduct experiments to provide valid conclusions.	**DA4:** Conduct investigations of *well-defined* problems; locate and search relevant codes and catalogues, conduct standard tests and measurements.
Modern Tool Usage: Level of understanding of the appropriateness of the tool	**WA5:** Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to *complex* engineering problems, with an understanding of the limitations. (WK6)	**SA5:** Select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to *broadly-defined* engineering problems, with an understanding of the limitations. (SK6)	**DA5:** Apply appropriate techniques, resources, and modern engineering and IT tools to *well-defined* engineering problems, with an awareness of the limitations. (DK6)

The Engineer and Society: Level of knowledge and responsibility	**WA6**: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems. (WK7)	**SA6**: Demonstrate understanding of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering technology practice and solutions to broadly defined engineering problems. (SK7)	**DA6**: Demonstrate knowledge of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering technician practice and solutions to well defined engineering problems. (DK7)
Environment and Sustainability: Type of solutions.	**WA7**: Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts. (WK7)	**SA7**: Understand and evaluate the sustainability and impact of engineering technology work in the solution of broadly defined engineering problems in societal and environmental contexts. (SK7)	**DA7**: Understand and evaluate the sustainability and impact of engineering technician work in the solution of well defined engineering problems in societal and environmental contexts. (DK7)
Ethics: Understanding and level of practice	**WA8**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. (WK7)	**SA8**: Understand and commit to professional ethics and responsibilities and norms of engineering technology practice. (SK7)	**DA8**: Understand and commit to professional ethics and responsibilities and norms of technician practice. (DK7)
Individual and Team work: Role in and diversity of team	**WA9**: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.	**SA9**: Function effectively as an individual, and as a member or leader in diverse teams.	**DA9**: Function effectively as an individual, and as a member in diverse technical teams.
Communication: Level of communication according to type of activities performed	**WA10**: Communicate effectively on *complex* engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	**SA10**: Communicate effectively on *broadly-defined* engineering activities with the engineering community and with society at large, by being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions	**DA10**: Communicate effectively on *well-defined* engineering activities with the engineering community and with society at large, by being able to comprehend the work of others, document their own work, and give and receive clear instructions
Project Management and Finance: Level of management required for differing types of activity	**WA11**: Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	**SA11**: Demonstrate knowledge and understanding of engineering management principles and apply these to one's own work, as a member or leader in a team and to manage projects in multidisciplinary environments.	**DA11**: Demonstrate knowledge and understanding of engineering management principles and apply these to one's own work, as a member or leader in a technical team and to manage projects in multidisciplinary environments
Lifelong learning: Preparation for and depth of continuing learning.	**WA12**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	**SA12**: Recognize the need for, and have the ability to engage in independent and life-long learning in specialist technologies.	**DA12**: Recognize the need for, and have the ability to engage in independent updating in the context of specialized technical knowledge.

6 Professional Competency Profiles

To meet the minimum standard of competence a person must demonstrate that he/she is able to practice competently in his/her practice area to the standard expected of a reasonable Professional Engineer/Engineering Technologist/Engineering Technician.

The extent to which the person is able to perform each of the following elements in his/her practice area must be taken into account in assessing whether or not he/she meets the overall standard.

Differentiating Characteristic	Professional Engineer	Engineering Technologist	Engineering Technician
Comprehend and apply universal knowledge: Breadth and depth of education and type of knowledge	**EC1:** Comprehend and apply advanced knowledge of the widely-applied principles underpinning good practice	**TC1:** Comprehend and apply the knowledge embodied in widely accepted and applied procedures, processes, systems or methodologies	**NC1:** Comprehend and apply knowledge embodied in standardised practices
Comprehend and apply local knowledge: Type of local knowledge	**EC2:** Comprehend and apply advanced knowledge of the widely-applied principles underpinning good practice specific to the jurisdiction in which he/she practices.	**TC2:** Comprehend and apply the knowledge embodied procedures, processes, systems or methodologies that is specific to the jurisdiction in which he/she practices.	**NC2:** Comprehend and apply knowledge embodied in standardised practices specific to the jurisdiction in which he/she practices.
Problem analysis: Complexity of analysis	**EC3:** Define, investigate and analyse complex problems	**TC3:** Identify, clarify, and analyse broadly-defined problems	**NC3:** Identify, state and analyse well-defined problems
Design and development of solutions: Nature of the problem and uniqueness of the solution	**EC4:** Design or develop solutions to complex problems	**TC4:** Design or develop solutions to broadly-defined problems	**NC4:** Design or develop solutions to well-defined problems
Evaluation: Type of activity	**EC5:** Evaluate the outcomes and impacts of complex activities	**TC4:** Evaluate the outcomes and impacts of broadly defined activities	**NC5:** Evaluate the outcomes and impacts of well-defined activities
Protection of society: Types of activity and responsibility to public	**EC6:** Recognise the reasonably foreseeable social, cultural and environmental effects of complex activities generally, and have regard to the need for sustainability; recognise that the protection of society is the highest priority	**TC6:** Recognise the reasonably foreseeable social, cultural and environmental effects of broadly-defined activities generally, and have regard to the need for sustainability; take responsibility in all these activities to avoid putting the public at risk.	**NC6:** Recognise the reasonably foreseeable social, cultural and environmental effects of well-defined activities generally, and have regard to the need for sustainability; use engineering technical expertise to prevent dangers to the public.

Legal and regulatory: No differentiation in this characteristic	**EC7:** Meet all legal and regulatory requirements and protect public health and safety in the course of his or her activities	**TC7:** Meet all legal and regulatory requirements and protect public health and safety in the course of his or her activities	**NC7:** Meet all legal and regulatory requirements and protect public health and safety in the course of his or her activities
Ethics: No differentiation in this characteristic	**EC8:** Conduct his or her activities ethically	**TC8:** Conduct his or her activities ethically	**NC8:** Conduct his or her activities ethically
Manage engineering activities: Types of activity	**EC9:** Manage part or all of one or more complex activities	**TC9:** Manage part or all of one or more broadly-defined activities	**NC9:** Manage part or all of one or more well-defined activities
Communication: No differentiation in this characteristic	**EC10:** Communicate clearly with others in the course of his or her activities	**TC10:** Communicate clearly with others in the course of his or her activities	**NC10:** Communicate clearly with others in the course of his or her activities
Lifelong learning: Preparation for and depth of continuing learning.	**EC11:** Undertake CPD activities sufficient to maintain and extend his or her competence	**TC11:** Undertake CPD activities sufficient to maintain and extend his or her competence	**NC11:** Undertake CPD activities sufficient to maintain and extend his or her competence
Judgement: Level of developed knowledge, and ability and judgement in relation to type of activity	**EC11:** Recognize complexity and assess alternatives in light of competing requirements and incomplete knowledge. Exercise sound judgement in the course of his or her complex activities	**TC12:** Choose appropriate technologies to deal with broadly defined problems. Exercise sound judgement in the course of his or her broadly-defined activities	**NC12:** Choose and apply appropriate technical expertise. Exercise sound judgement in the course of his or her well-defined activities
Responsibility for decisions: Type of activity for which responsibility is taken	**EC12:** Be responsible for making decisions on part or all of complex activities	**TC13:** Be responsible for making decisions on part or all of one or more broadly defined activities	**NC13:** Be responsible for making decisions on part or all of all of one or more well-defined activities

Appendix A: Definitions of terms

Note: These definitions apply to terms used in this document but also indicate equivalence to terms used in other engineering education standards.

Branch of engineering: a generally-recognised, major subdivision of engineering such as the traditional *disciplines* of Chemical, Civil, or Electrical Engineering, or a cross-disciplinary field of comparable breadth including combinations of engineering fields, for example Mechatronics, and the application of engineering in other fields, for example Bio-Medical Engineering.

Broadly-defined engineering problems: a class of problem with characteristics defined in section 4.1.

Broadly-defined engineering activities: a class of activities with characteristics defined in section 4.2.

Complementary (contextual) knowledge: Disciplines other than engineering, basic and mathematical sciences, that support engineering practice, enable its impacts to be understood and broaden the outlook of the engineering graduate.

Complex engineering problems: a class of problem with characteristics defined in section 4.1.

Complex engineering activities: a class of activities with characteristics defined in section 4.2.

Continuing Professional Development: the systematic, accountable maintenance, improvement and broadening of knowledge and skills, and the development of personal qualities necessary for the execution of professional and technical duties throughout an engineering practitioner's career.

Engineering sciences: include engineering fundamentals that have roots in the mathematical and physical sciences, and where applicable, in other natural sciences, but extend knowledge and develop models and methods in order to lead to applications and solve problems, providing the knowledge base for engineering specializations.

Engineering design knowledge: Knowledge that supports engineering design in a practice area, including codes, standards, processes, empirical information, and knowledge reused from past designs.

Engineering discipline: synonymous with *branch of engineering*.

Engineering fundamentals: a systematic formulation of engineering concepts and principles based on mathematical and natural sciences to support applications.

Engineering management: the generic management functions of planning, organising, leading and controlling, applied together with engineering knowledge in contexts including the management of projects, construction, operations, maintenance, quality, risk, change and business.

Engineering problem: is a problem that exists in any domain that can be solved by the application of engineering knowledge and skills and generic competencies.

Engineering practice area: a generally accepted or legally defined area of engineering work or engineering technology.

Engineering speciality or specialization: a generally-recognised practice area or major subdivision within an engineering discipline, for example Structural and Geotechnical Engineering within Civil Engineering; the extension of engineering fundamentals to create theoretical frameworks and bodies of knowledge for engineering practice areas.

Engineering technology: is an established body of knowledge, with associated tools, techniques, materials, components, systems or processes that enable a family of practical applications and that relies for its development and effective application on engineering knowledge and competency.

Forefront of the professional discipline/branch[6]: defined by advanced practice in the specialisations within the discipline.

Formative development: the process that follows the attainment of an accredited education programme that consists of training, experience and expansion of knowledge.

Manage: means planning, organising, leading and controlling in respect of risk, project, change, financial, compliance, quality, ongoing monitoring, control and evaluation.

Mathematical sciences: mathematics, numerical analysis, statistics and aspects of computer science cast in an appropriate mathematical formalism.

Natural sciences: Provide, as applicable in each engineering discipline or practice area, an understanding the physical world including physics, mechanics, chemistry, earth sciences and the biological sciences,

Practice area: *in the educational context:* synonymous with generally-recognised engineering speciality; *at the professional level:* a generally recognised or distinctive area of knowledge and expertise developed by an engineering practitioner by virtue of the path of education, training and experience followed.

Solution: means an effective proposal for resolving a problem, taking into account all relevant technical, legal, social, cultural, economic and environmental issues and having regard to the need for sustainability.

Subdiscipline: Synonymous with *engineering speciality*.

Substantial equivalence: applied to educational programmes means that two or more programmes, while not meeting a single set of criteria, are both acceptable as preparing their respective graduates to enter formative development toward registration.

Well-defined engineering problems: a class of problem with characteristics defined in section 4.1.

Well-defined engineering activities: a class of activities with characteristics defined in section 4.2.

[6] This should be distinguished from: **Forefront of knowledge in an engineering discipline/speciality**: defined by current published research in the discipline or speciality.

Appendix B: History of Graduate Attributes and Professional Competency Profiles

The signatories to the Washington Accord recognized the need to describe the attributes of a graduate of a Washington Accord accredited program. Work was initiated at its June 2001 meeting held at Thornybush, South Africa. At the International Engineering Meetings (IEM) held in June 2003 at Rotorua, New Zealand, the signatories to the Sydney Accord and the Dublin Accord recognized similar needs. The need was recognized to distinguish the attributes of graduates of each type of programme to ensure fitness for their respective purposes.

The Engineers Mobility Forum (EMF) and Engineering Technologist Mobility Forum (ETMF)[7] have created international registers in each jurisdiction with current admission requirements based on registration, experience and responsibility carried. The mobility agreements recognize the future possibility of competency-based assessment for admission to an international register. At the 2003 Rotorua meetings, the mobility fora recognized that many jurisdictions are in the process of developing and adopting competency standards for professional registration. The EMF and the ETMF therefore resolved to define assessable sets of competencies for engineer and technologist. While no comparable mobility agreement exists for technicians, the development of a corresponding set of standards for engineering technicians was felt to be important to have a complete description of the competencies of the engineering team.

Version 1

A single process was therefore agreed to develop the three sets of graduate attributes and three professional competency profiles. An International Engineering Workshop (IEWS) was held by the three educational accord and the two mobility fora in London in June 2004 to develop statements of Graduate Attributes and International Register Professional Competency Profiles for the Engineer, Engineering Technologist and Engineering Technician categories. The resulting statements were then opened for comment by the signatories. The comments received called for minor changes only.

The Graduate Attributes and Professional Competencies were adopted by the signatories of the five agreements in June 2005 at Hong Kong as version 1.1.

Version 2

A number of areas of improvement in the Graduate Attributes and Professional Competencies themselves and their potential application were put to the meetings of signatories in Washington DC in June 2007. A working group was set up to address the issues. The IEA workshop held in June 2008 in Singapore considered the proposals of the working group and commissioned the Working Group to make necessary changes with a view to presenting Version 2 of the document for approval by the signatories at their next general meetings. Version 2 was approved at the Kyoto IEA meetings, 15-19 June 2009.

Version 3

Between 2009 and 2012 a number of possible improvements to the graduate attributes were recorded. During 2012 signatories performed an analysis of gaps between their respective standards and the Graduate Attribute exemplars and by June 2013 most signatories reported substantial equivalence of their standards to the Graduate Attributes. This will be further examined in periodic monitoring reviews in 2014 to 2019. In this process a number of improvements to the wording of the Graduate Attributes and supporting definitions were identified. The signatories to the Washington, Sydney and Dublin Accords approved the changes resulting in this Version 3 at their meetings in Seoul 17-21 June 2013. Signatories stated that the objectives of the changes were to clarify aspects of the Graduate Attribute exemplar. There was no intent to raise the standard. The main changes were as follows:

- New Section 2.3 inserted;
- Range of problem solving in section 4.1 linked to the Knowledge Profiles in section 5.1 and duplication removed;
- Graduate Attributes in section 5.2: cross-references to Knowledge Profile elements inserted; improved wording in attributes 6, 7 and 11;
- Appendix A: definitions of *engineering management* and *forefront of discipline* added.

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[7] Now the IEPA and IETA respectively.