BOARD NOTICE

BOARD NOTICE 36 OF 2012

Engineering Council of South Africa
Invitation to Comment on the Proposed ECSA Technology Qualification Standards

ECSA

1. Background

The HEQF compliant qualifications attached were developed to replace the NATED qualifications and to comply with the Policy on Higher Education Qualifications: Oct 2007. The following information is found in the policy:

- It replaces NATED 116, 150 & 151
- Makes the HEQF an integral part of the NQF
- It is based on a 10-level NQF
- Sets common parameters and criteria for the design of higher education qualifications.

The attached qualifications are:

NO.	TITLE	LEVEL	CREDIT(S)	EDUCATIONAL REQUIREMENT
1	Higher Certificate in Engineering	05	140	Specified Category
2	Advanced Certificate in Engineering	06	140	Professional Technician
3	Diploma in Engineering	06	360	Professional Technician
4	Advance Diploma in Engineering	07	140	Professional Technologist/ Professional Certificated Engineer
5	Bachelor of Engineering Technology	07	420	Professional Technologist/ Professional Certificated Engineer

2. QUALIFICATIONS GENERATION PROCESS

The Engineering Standards Generating Body (ESGB) undertook the work of developing the Bachelor of Engineering Technology, the Advanced Diploma in Engineering, the Diploma in Engineering, the Advanced Certificate in Engineering and the Higher Certificate in Engineering Qualifications in **Standards Generating Groups**. These Standards Generating Groups comprised of an ESGB member as chairperson and forty other technical experts, which represented stakeholders (including providers, industry, professional institutes, SETAs and state departments).

3. PURPOSE FOR THE PROCESS

The Technology Programme Accreditation Committee (TPAC) of ECSA, has recognised the need for developing standards for technology qualifications aligned to the Revised HEQF. This has come about for the following reasons.

- The qualifications reflected in NATED Reports 116, 150 and 151 are to be phased out.
- The Standards for the HEQF technology qualifications required the development of Exit Level Outcomes.
- ECSA is a signatory to the Dublin Accord (Technicians) and the Sydney Accord (Technologist) which will in future use their Graduate Attributes as its base for judging the substantial equivalency of programmes accredited by signatories. ECSA has, along with other signatories, undergone a Gap Analysis in which gaps between the signatory's qualification standard and the Graduate Attributes are identified and a plan for closing the Gaps over time is formulated. While the alignment of the ECSA Standard and the Graduate Attributes is largely complete, the TPAC proposes to complete the alignment through a number of changes.

The proposed standards resulting from this process is now published for comment. A revision will be made as a result of the comments and the document put to the ECSA Council for approval. A phasing-in period will be announced thereafter.
The BEng Tech, Advanced Diploma, Diploma, Advanced Certificate and Higher Certificate standards rely on the ECSA policy document E-01-P: Background the Accreditation of Engineering Programmes for definitions and the definition of the formula for calculating credits.

4. SUBMISSION OF COMMENTS

Interested parties are requested to submit comments not later than **Friday 30 March 2012** by e-mail to the ECSA Education Manager, Samantha Naidoo at Samantha@ecsa.co.za.

Advanced Diploma 2012 – Public Comment
Engineering Council of South Africa

ECSA

Engineering Standards Generating Body

HEQF-COMPLIANT GENERIC ENGINEERING QUALIFICATIONS: Advanced Diploma

FIELD: Manufacturing, Engineering and Technology

SUBFIELD: Engineering and Related Design

NQF LEVEL: 7

CREDITS: 140

Minimum Credits at Exit Level 7: 120

TITLE: Advanced Diploma in Engineering

Qualification Qualifiers

The qualification may have a disciplinary or cross-disciplinary qualifier (discipline, branch, option or endorsement) defined in the provider's rules for the Advanced Diploma and reflected on the academic transcript and Advanced Diploma certificate, subject to the following:

1. There must be at least one qualifier which contains the word engineering together with a disciplinary description such as: Agricultural, Aeronautical, Chemical, Civil, Computer, Electrical, Electro-mechanical, Electronic, Environmental, Industrial, Extractive Metallurgical, Mechanical, Mechatronics, Metallurgical, Mineral(s) Processing, Physical Metallurgical and Mining. Qualifiers are not restricted to this list.

2. A second qualifier, if present, must indicate a focus area within the field of the first qualifier.

3. The qualifier(s) must:
   - clearly indicate the nature and purpose of the programme.
   - be consistent with the fundamental engineering science content of the programme.
   - be comparable with typical programmes within the Sydney Accord Signatories.

4. The target market indicated by the qualifier(s) may be a traditional discipline of engineering or a branch of engineering or a substantial industrial sector. Formal education for niche markets should be satisfied by broad undergraduate programmes such as specified in this standard followed by specialized course-based programmes.

Examples of acceptable designations in accordance with HEQF policy are:

- Advanced Diploma in Civil Engineering in Structures, abbreviated Adv. Dip. (Civil) (Structures)
- Advanced Diploma in Civil Engineering, Environmental Engineering abbreviated Adv. Dip. (Civil Engineering) (Environmental)

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RATIONALE FOR THE QUALIFICATION

The Engineering profession contributes to the technological, socio-economic, built environment and environmental infrastructure of the country, facilitating socio-economic growth and sustainability. (Refer to ANNEXURE 1 for the characteristics of engineering activities)

The target markets include both a traditional branch of engineering, and/or a significant industrial area. The qualification is the starting point of a career path in one of the areas of specialization, but is still generic enough to allow maximum mobility, based on recognition of prior learning, within the industry. Skills, knowledge, values and attitudes reflected in the qualification are building blocks for the development of candidate engineering technologists and certificated engineers towards becoming competent engineering professionals.

This qualification in Engineering Technology at Level 7 is designed to meet the needs of the country in respect of engineering competence.

The qualification is intended to:

- Promote the development of engineering knowledge and skills that are required to serve public and private needs.
- Release the potential of people.
- Provide opportunities for people to move up the value chain.
- Provide students with life-long learning and articulation opportunities in the engineering profession.

Characteristic Profiles of Professional Engineering Technologists and Certificated Engineers

Technologist

Professional Engineering Technologists are characterized by the ability to apply established and newly developed engineering technology to solve *broadly- defined* problems, develop components, systems, services and processes.

They provide leadership in the application of technology in safety, health, technical and commercially effective operations and have well-developed interpersonal skills.

They work independently and responsibly, applying judgement to decisions arising in the application of technology and health and safety considerations to problems and associated risks.

Professional Engineering Technologists have a specialized understanding of engineering sciences underlying a deep knowledge of specific technologies together with financial, commercial, legal, social and economic, health, safety and environmental matters.

Certificated Engineer

Professional Certificated Engineers are characterized by the ability to apply established and newly developed engineering technology to solve broadly defined problems, develop components, systems, services and processes in specific areas where a legal appointment is required in terms of either the Occupational Health and Safety Act, the Mines Health and Safety Act, or the Merchant Shipping Act, e.g. large factories, mines and marine environments.

They provide leadership in safety, health, technical and commercially effective operations and have well-developed management skills.

They work independently and responsibly, applying judgement to decisions arising in the application of technology and health and safety considerations to problems and associated risks.

Professional Certificated Engineers have a specialized understanding of engineering sciences underlying manufacturing, marine, mining, plant and operations, together with financial, commercial, legal, social and economic, health, safety and environmental methodologies, procedures and best practices.

PURPOSE OF THE QUALIFICATION

This qualification is primarily industry oriented. The knowledge emphasises general principles and application or technology transfer. The qualification provides students with a sound knowledge base in a particular field or discipline and the ability to apply their knowledge and skills to particular career or professional contexts, while equipping them to undertake more specialised and intensive learning. Programmes leading to this qualification tend to have a strong professional or career focus and holders of this qualification are normally prepared to enter a specific niche in the labour market.

Specifically the purpose of educational programmes designed to meet this qualification are to build the necessary knowledge, understanding, abilities and skills required for further learning towards becoming a competent practicing engineering technologist or certificated engineer. This qualification provides:

1. Preparation for careers in engineering and areas that potentially benefit from engineering skills, for achieving technical proficiency and to make a contribution to the economy and national development;
2. The educational base required for registration as a Professional Engineering Technologist and/or Certificated Engineer with ECSA. (refer to qualification rules)
3. Entry to NQF level 8 programmes e.g. Honours, Post Graduate Diploma and B Eng Programmes and then to proceed to Masters Programmes.
4. For certificated engineers, this provides the education base for achieving proficiency in mining / factory plant and marine operations and occupational health and safety.

Engineering students completing this qualification will demonstrate competence in all the Exit Level Outcomes contained in this standard.

MINIMUM ADMISSION REQUIREMENTS

It is assumed that students have completed a Diploma in Engineering or a substantially equivalent qualification.

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RECOGNITION OF PRIOR LEARNING

Recognition of prior learning (RPL) may be used to demonstrate competence for admission to this programme. This qualification may be achieved in part through recognition of prior learning processes. Credits achieved by RPL must not exceed 50% of the total credits and must not include credits at the exit level.

1. The process is quality assured by the provider;
2. The provider comprehensively assesses student's performance against defined outcomes that are relevant to the discipline; and
3. The learning is documented and presented in the accreditation process.

PROGRESSION

Completion of the Advanced Diploma meets the minimum entry requirement for admission to an appropriate Honours degree or Postgraduate qualification.

QUALIFICATION RULES

The programme leading to the qualification shall contain a minimum of 140 SAQA credits. Credits shall be distributed in order to create a coherent progression of learning toward the exit level.

Knowledge Profile of the Graduate:

The content of the educational programme when analysed by knowledge area shall not fall below the minimum credits in each knowledge area as listed below.

Table 1:Minimum credits in knowledge areas	
Total	140
Mathematical Sciences	14
Natural Sciences	7
Engineering Sciences	28
Engineering Design	21
Computing and IT	7
Complementary Studies	14
For re-allocation	49

Credits available for reallocation must be assigned to the six knowledge areas to form a coherent, balanced programme.

The method of calculation of credits and allocation to knowledge areas is defined in ECSA document E-02-PN. (Refer to ANNEXURE 2)

Core and specialist requirements

The programme shall have a coherent core of mathematics, basic sciences and fundamental engineering sciences totalling not less than 50% of the total credits that provides a viable platform for further studies and lifelong learning. The coherent core must enable development in a traditional discipline or in an emerging field. The coherent core includes fundamental elements. The provider may allow elective credits, subject to the minimum credits in each knowledge area and the exit level outcomes being satisfied for all choices.

A programme shall contain specialist engineering study at the exit level. Specialist study may lead to elective or compulsory credits. Specialist study may take on many forms including further deepening of a theme in the core, a new sub-discipline, or a specialist topic building on the core. It is recognized that the extent of specialist study is of necessity limited in view of the need to provide a substantial coherent core. Specialist study may take the form of compulsory or elective credits.

In the Complementary Studies area, it covers those disciplines outside of engineering sciences, basic sciences and mathematics which are relevant to the practice of engineering in two ways: (a) principles, results and method are applied in the practice of engineering, including engineering economics, the impact of technology on society and effective communication; and (b) study broadens the student's perspective in the humanities or social sciences to support an understanding of the world. Underpinning Complementary Studies knowledge of type (b) must be sufficient and appropriate to support the student in satisfying Exit Level Outcomes 6, 7 and 10 in the graduates specialized practice area.

Curriculum Content

This qualification does not specify detailed curriculum content. The fundamental and specialist engineering science content must be consistent with the designation of the qualification.

Designers of specific qualifications may build on this generic base by specifying occupation-related content and specific skills required. The particular occupation may also require other qualifications, learnerships, skills programmes or further learning.

Work Integrated Learning (Refer to ANNEXURE 3)

If the provider includes work integrated learning into the programme:

1. It must ensure that all students have the opportunity to undertake work-integrated learning (WIL).
2. Credits must only be included in the knowledge breakdown if:
   - The work is quality assured by the provider;
   - The provider comprehensively assesses student's performance against defined outcomes that are relevant to the discipline; and
   - The learning is documented and presented in the accreditation process.

Work Integrated Learning (WIL) can be performed as an individual or in a team in any one or a combination of the following curricular types:

- Work-Directed Theoretical Learning
- Problem-Based Learning
- Project-Based Learning
- Work-Place Learning
- Simulated Learning

Note 1: Work activities include assisting, contributing, observing and applying at least four of the specific practices below:

- Engineering processes, skills and tools, including measurement.
- Investigations, experiments and data analysis.
- Problem solving techniques.
- Application of scientific and engineering knowledge;
- Engineering planning and design;
- Professional and technical communication;
- Individual and teamwork; or
- The impact of engineering activity on health, safety and the environment.

Knowledge Area Definitions

Natural Sciences: physics (including mechanics), chemistry, earth sciences and the biological sciences which focus on understanding the physical world, as applicable in each engineering disciplinary context.
Complementary Studies: cover those disciplines outside of engineering sciences, basic sciences and mathematics which are relevant to the practice of engineering in 2 ways: (a) principles, results and methods are applied in the practice of engineering, including engineering economics, the impact of technology on society and effective communication; and (b) study broadens the student's perspective in the humanities or social sciences to support an understanding of the world.
Computing and Information Technologies: encompasses the use of computers, networking and software to support engineering activity and as an engineering activity in itself as appropriate to the discipline.
Engineering Sciences: have roots in the mathematical and physical sciences, and where applicable, in other basic sciences but extend knowledge and develop models and methods in order to lead to engineering applications and solve engineering problems.
Mathematical Sciences: an umbrella term embracing the techniques of mathematics, numerical analysis, statistics and aspects of computer science cast in an appropriate mathematical formalism.
Engineering Design and Synthesis: is the systematic process of conceiving and developing materials, components, systems and processes to serve useful purposes. Design may be procedural, creative or open-ended and requires application of engineering sciences, working under constraints, and taking into account economic, health and safety, social and environmental factors, codes of practice and applicable laws.

EXIT LEVEL OUTCOMES

Exit Level Outcomes defined below are stated generically and may be assessed in various engineering disciplinary or cross-disciplinary contexts in a provider-based or simulated practice environment.

General Range Statement: The competencies defined in the ten exit level outcomes may be demonstrated in a provider-based and / or simulated workplace context. The term "*broadly-defined*" applicable to this qualification is defined in ANNEXURE 4.

Exit Level Outcome 1: Apply engineering principles to systematically diagnose and solve *broadly-defined* engineering problems.

Associated Assessment Criteria:

1.1 The problem is analysed and defined and criteria are identified for an acceptable solution.
1.2 Relevant information and engineering knowledge and skills are identified and used for solving the problem.
1.3 Various approaches are considered and formulated that would lead to workable solutions.
1.4 Solutions are modelled and analysed.
1.5 Solutions are evaluated and the best solution is selected.
1.6 The solution is formulated and presented in an appropriate form.

Range Statement: Knowledge of engineering principles to solve *broadly-defined* engineering problems.

Exit Level Outcome 2: Apply knowledge of mathematics, natural science and engineering sciences to defined and applied engineering procedures, processes, systems and methodologies to solve *broadly-defined* engineering problems.

Associated Assessment Criteria:

2.1 An appropriate mix of knowledge of mathematics, numerical analysis, statistics, natural science and engineering science at a fundamental level and in a specialist area is brought to bear on the solution of *broadly-defined* engineering problems.
2.2 Theories, principles and laws are used.
2.3 Formal analysis and modelling is performed on engineering materials, components, systems or processes.
2.4 Concepts, ideas and theories are communicated.
2.5 Reasoning about and conceptualising engineering materials, components, systems or processes is performed.
2.6 Uncertainty and risk is handled through the use of probability and statistics.
2.7 Work is performed within the boundaries of the practice area.

Range Statement: Knowledge of mathematics, natural science and engineering science is characterized by:

- A knowledge of mathematics using formalism and oriented toward engineering analysis and modelling; fundamental knowledge of natural science: both as relevant to a sub-discipline or recognised practice area.
- A coherent range of fundamental principles in engineering science and technology underlying an engineering sub-discipline or recognised practice area.
- A systematic body of established and emerging knowledge in a specialist area or recognized practice area.
- the use of mathematics, natural science and engineering science, supported by established models, to aid solving *broadly-defined* engineering problems.

Note: Problems or projects used for assessment may provide evidence in the application of one or more categories of knowledge listed above.

Exit Level Outcome 3: Perform procedural and non-procedural design of *broadly defined* components, systems, works, products or processes to meet desired needs normally within applicable standards, codes of practice and legislation.

Associated Assessment Criteria:

3.1 The design problem is formulated to satisfy user needs, applicable standards, codes of practice and legislation.
3.2 The design process is planned and managed to focus on important issues and recognises and deals with constraints.
3.3 Knowledge, information and resources are acquired and evaluated in order to apply appropriate principles and design tools are evaluated and used to provide a workable solution.
3.4 Design tasks are performed including analysis, quantitative modelling and optimisation of the product, system or process subject to the relevant premises, assumptions, constraints and restrictions.
3.5 Alternatives are evaluated for implementation and a preferred solution is selected based on techno-economic analysis and judgement.
3.6 The selected design is assessed in terms of the social, economic, legal, health, safety, and environmental impact and benefits.
3.7 The design logic and relevant information is communicated in a technical report.

Range Statement: Design problems used in assessment must conform to the definition of *broadly-defined* engineering problems.

- A major design project should be used to provide a body of evidence that demonstrates this outcome.
- The project would be typical of that which the graduate would participate in a typical employment situation after graduation.
- The selection of components, systems, engineering works, products or processes to be designed is dependent on the sub-discipline.

Exit Level Outcome 4: Define and conduct investigations and experiments of *broadly-defined* problems.

Associated Assessment Criteria:

4.1. Investigations and experiments are planned, designed and conducted within an appropriate discipline.
4.2. Relevant literature including codes is searched and material is critically evaluated for suitability to the investigation.
4.3. Analysis is performed as necessary to the investigation.
4.4. Equipment or software is selected and used as appropriate in the investigations.
4.5. Information from relevant data is derived, analysed and interpreted.
4.6. Conclusions are drawn from an analysis of all relevant evidence.
4.7. The purpose, process and outcomes of the investigation are recorded in a technical report.

Range Statement: The balance of investigation and experiment should be appropriate to the discipline. An investigation or experimental study should be typical of those in which the graduate would participate in an employment situation after graduation.

Note: An investigation differs from a design in that the objective is to produce knowledge and understanding of a phenomenon.

Exit Level Outcome 5: Use appropriate techniques, resources, and modern engineering tools, including information technology, prediction and modelling, for the solution of *broadly-defined* engineering problems, with an understanding of the limitations, restrictions, premises, assumptions and constraints.

Associated Assessment Criteria:
5.1 The method, skill or tool is selected and assessed for applicability and limitations against the required result.
5.2 The method, skill or tool is applied correctly to achieve the required result.
5.3 Results produced by the method, skill or tool are critically tested and assessed against required results.
5.4 Computer applications are created, selected and used as required by the discipline

Range Statement: A range of methods, skills and tools appropriate to the sub-discipline of the program including:
- Sub-discipline-specific tools, processes or procedures.
- Computer packages for computation, modelling, simulation, and information handling;
- Computers and networks and information infra-structures for accessing, processing, managing, and storing information to enhance personal productivity and teamwork;
- Techniques from economics, management, and health, safety and environmental protection.

Exit Level Outcome 6: Communicate effectively, both orally and in writing, with engineering audiences and the affected parties.

Associated Assessment Criteria:
6.1 The structure, style and language of written and oral communication are appropriate for the purpose of the communication and the target audience.
6.2 Graphics used are appropriate and effective in enhancing the meaning of text.
6.3 Visual materials used enhance oral communications.
6.4 Accepted methods are used for providing information to others involved in the engineering activity.
6.5 Oral communication is delivered fluently with the intended meaning being apparent.
6.6 Written communications meet the requirement of the intended audience

Range Statement: Material to be communicated is in an academic or simulated professional context.
- Audiences range from engineering peers, related engineering personnel and lay persons.
- Appropriate academic or professional discourse is used.
- Written reports range from short (300-1000 words plus tables and diagrams) to long (10 000 to 15 000 words plus tables, diagrams and appendices), covering material at exit level.
- Methods of providing information include the conventional methods of the discipline, for example engineering drawings, as well as subject-specific methods.

Exit Level Outcome 7: Demonstrate knowledge and understanding of the impact of engineering activity on the society, economy, industrial and physical environment, and address issues by analysis and evaluation and the need to act professionally within own limits of competency.

Associated Assessment Criteria:
7.1 The impact of technology is identified and dealt with in terms of the benefits and limitations to society.
7.2 The engineering activity is analysed in terms of the impact on occupational and public health and safety.
7.3 The engineering activity is analysed in terms of the impact on the physical environment.
7.4 Personal, social, economic, cultural values and requirements of those who are affected by the engineering activity are taken into consideration.

Range Statement: The combination of social, workplace (industrial) and physical environmental factors must be appropriate to the sub-discipline of the qualification. Evidence may include case studies typical of the technological practice situations in which the graduate is likely to participate.

Issues and impacts to be addressed:
- Are generally within, but may be partially outside of standards and code of practice;
- Involve several groups of stakeholders with differing and conflicting needs;
- Have consequences that are locally important but may extend more widely;
- Are *broadly-defined* and maybe part of, or a system within a wider engineering system.

Exit Level Outcome 8: Demonstrate knowledge and understanding of engineering management principles and apply these to one's own work, as a member or leader in a diverse team and to manage projects

Associated Assessment Criteria:
8.1 The principles of planning, organising, leading and controlling are explained.
8.2 Individual work is carried out effectively and on time.
8.3 Contributions to team activities that support the output of the team.
8.4 A design or research project is organised and managed.
8.5 Effective communication is carried out in the context of individual or team work.
8.6 Critical functions in the team are performed and work is completed on time.

Range Statement:
- The ability to manage a project should be demonstrated in the form of the project indicated in ELO 3 or ELO 4.
- Tasks are discipline specific and within the technical competence of the graduate.
- Management principles include:
  - Planning: set objectives, select strategies, implement strategies and review achievement.
  - Organising: set operational model, identify and assign tasks, identify inputs, delegate responsibility and authority.
  - Leading: give directions, set example, communicate, motivate.
  - Controlling: monitor performance, check against standards, identify variations and take remedial action.

Exit Level Outcome 9: Engage in independent/life-long learning through well-developed learning skills.

Associated Assessment Criteria:

9.1 Learning tasks are managed autonomously and ethically, individually and in learning groups.
9.2 Learning undertaken is reflected on and individual learning requirements and strategies are determined to suit personal learning style and preferences
9.3 Relevant information is sourced, organised and evaluated
9.4 Knowledge acquired outside of formal instruction is comprehended and applied
9.5 Assumptions are challenged critically and new thinking is embraced

Range Statement: The learning context is *broadly-defined*, varying and sometimes unfamiliar. Some information is drawn from the technological literature.

Exit Level Outcome 10: Comprehend and apply ethical principles and commit to professional ethics, responsibilities and norms of engineering practice within own limits of competence.

Associated Assessment Criteria:

10.1 The nature and complexity of ethical dilemmas are described.
10.2 The ethical implications of decisions made are described.
10.3 Ethical reasoning is applied to evaluate engineering solutions.
10.4 Awareness is displayed of the need to maintain continued competence through keeping abreast of up to date tools and techniques available in the workplace.
10.5 The system of continuing professional development is understood and embraced as an on-going process.
10.6 Responsibility is accepted for consequences stemming from own actions.
10.7 Judgements are made in decision making during problem solving and design.
10.8 Decision making is limited to the area of current competence.

Range Statement: Evidence includes case studies typical of engineering practice situations in which the graduate is likely to participate.
The range of the candidates' activity;

- Is generally within, but may be partially outside of standards and codes of practice
- Involves several groups of stakeholders with differing and conflicting needs
- Has consequences that are locally important but may extend more widely.
- Is *broadly-defined* and is part of, or a system within complex engineering systems.

CRITICAL CROSS-FIELD OUTCOMES

This qualification promotes, in particular, the following Critical Cross-Field Outcomes:

1. Identifying and solving problems in which responses indicate that responsible decisions using critical and creative thinking have been made when:
   - In the problem solving process defined by the assessment criteria of Exit-level Outcomes 1, 3, 4 and 5, the learner is expected to be both creative and critical.
2. Working effectively with others as a member of a group, organization and community during:
   - Exit-level outcome 8 explicitly requires the learners to demonstrate effectiveness in individual work and the ability to function in a team situation.

- Exit level Outcome 6 covers communication, including receiving advice from supervisors.

3. Organizing and managing oneself and one's activities responsibly and effectively when:
   - The Assessment Criteria to Exit-level Outcomes 1, 2, 3, 4 and 9 stress a systematic approach in which the learner manages the process. Exit level 8 explicitly calls for self management while 10 calls for a professional approach.
4. Collecting, analyzing, organizing and critically evaluating information to better understand and explain by:
   - The Assessment Criteria to Exit-level Outcomes 1, 2, 3, 4, 9 and 10 explicitly or implicitly require information to be gathered, organised and critically evaluated.
5. Communicating effectively using visual, mathematical and / or language skills in the modes of oral and / or written persuasion when:
   - In addition to the specific requirements in Exit-level outcomes 3 and 4 to communicate the outputs of design and investigations, Exit-level outcome 6 calls for a range of communication modes and activities. Use of mathematics for expressing and communicating concepts is part of Exit Level Outcome 2.
6. Using science and technology effectively and critically, showing responsibility towards the environment and health of others when:
   - On one hand, this is essentially a science and technology-based qualification while on the other, Exit level outcome 7 requires that the impacts of such science and technology based activity be assessed and measures devised to minimise the impacts.
7. Demonstrating and understanding of the world as a set of related systems by recognizing that problem-solving contexts do not exist in isolation when:
   - Across the Exit-level Outcomes, problem solving, design and investigation competencies are formulated to call for a holistic approach taking technical, social, economic, environmental factors into account.

INTERNATIONAL COMPARABILITY

International comparability of this engineering technologist education qualification is ensured through the Sydney Accord.

The exit level outcomes and level descriptors defined in this qualification are aligned with the attributes of a Sydney Accord technologist graduate in the International Engineering Alliance's Graduate Attributes and professional Competencies (See www.ieagreements.org). Current signatories to the Sydney Accord are: Engineering Council UK, Engineers Ireland, Engineering Council of South Africa, Engineers Australia, The Hong Kong Institute of Engineers, Institution of Professional Engineers New Zealand, Accreditation Board for Engineering and Technology and the Canadian Council of Technicians and Technologists. Provisional members working towards signatory status in the Sydney Accord is the Accreditation Board for Engineering Education of Korea.

ANNEXURES

ANNEXURE 1: Engineering Activity

Engineering is an activity that is best defined by the following distinguishing characteristics:

1. It encompasses initiatives, services and the solution of problems that are of importance to society and the economy.
2. Engineering activity brings benefits through exploiting natural resources, harnessing energy, using materials with beneficial properties, using machinery and equipment, transferring, storing and processing information, constructing, operating and maintaining infrastructure and plant, and the organisation and control of systems or processes. These actions involve risks, requiring engineering activity to be conducted with due regard to safety, health, environmental and sustainability considerations.
3. Engineering functions include: designing materials, components, systems or processes; planning the capacity and location of infrastructure; investigating, advising and reporting on engineering problems; improvement of materials, components, systems or processes; managing or operating plant and processes; managing implementation or construction projects; implementing designs or solutions; research, development and commercialization of products.
4. Engineering activity requires a body of knowledge and distinctive competencies. The body of knowledge is based on mathematics, natural sciences, engineering sciences, information technology and contextual knowledge including legal, financial and regulatory aspects. Distinctive competencies include indentifying problems and designing solutions, managing activities, addressing impacts of solutions and activities and acting ethically, applying judgement and taking responsibility.
5. The practice of engineering activities at professional level involves a number of roles, recognized in specified categories of registration under the Engineering Profession Act.

ANNEXURE 2: Method of Calculation of Credits and Allocation to Knowledge Area

The method of calculation assumes that certain activities are scheduled on a regular weekly basis while others can only be quantified as a total activity over the duration of a course or module. This calculation makes the following assumptions:

1. Classroom or other scheduled contact activity generates notional hours of the student's own time for each hour of scheduled contact. The total is given by a multiplier applied to the contact time.
2. Two weeks of full-time activity accounts for assessment in a semester.
3. Assigned work generates only the notional hours judged to be necessary for completion of the work and is not multiplied.

Define for each course or module identified in the rules for the degree: Type of Activity, Time Unit in Hours and Contact Time Multiplier

The credit for the course is: $C = \{W (L*T_L *M_L + T*T_T *M_T) + P*T_P *M_P + X*T_X *M_X + A*T_A\}/10$

Where:

L	= number of lectures per week,
T_L	= duration of a lecture period
M_L	= total work per lecture period
T	= number of tutorial per week
T_T	= duration of a tutorial period
M_T	= total work per tutorial period
P	= total practical periods
T =	duration of a practical period

M_P	= total work per practical period
X	= total other contact periods
T_X	= duration of other period
M_X	= total work per other period
A	= total assignment non-contact Hours
T_A	= 1 hour
W	= number of weeks the course lasts (actual + 2 week per semester for examinations, if applicable to the course or module)

The resulting credit for a course or value may be divided between more than one knowledge area. In allocating the credit for a course to multiple knowledge areas, only new knowledge or skills in a particular area may be counted. Knowledge and skills developed in other courses and used in the course in question shall not be counted. Such knowledge is classified by the nature of the area in which it is applied. In summary, no knowledge is counted more than once as being new.

ANNEXURE 3: Work Integrated Learning (WIL)

WIL can be defined as an "active" teaching and learning strategy that can be used to develop a whole range of desired graduate attributes. It can draw together a whole range of knowledge areas and skills and present opportunities for students to practice and develop: higher order cognitive skills (problem solving, analysis, decision making, critical thinking), disciplinary knowledge, interdisciplinary knowledge, self-directed learning and lifelong learning skills, and desired practical and behavioural skills by placing students in the active role of practitioners in a 'real world' or authentic learning environment.

Work Integrated Learning activities include assisting, contributing, observing and applying at least four of the specific practices below:

- Engineering processes, skills and tools, including measurement.
- Investigations, experiments and data analysis.
- Problem solving techniques.
- Application of scientific and engineering knowledge;
- Engineering planning and design;
- Professional and technical communication;
- Individual and teamwork; or
- The impact of engineering activity on health, safety and the environment.

The WIL guidelines published by the Council on Higher Education (CHE) titled ***Work-Integrated Learning: Good Practice Guide*** provides an overview of the most common forms of WIL practice. These include:

- Work-directed theoretical learning
- Problem-based learning
- Project-based learning
- Workplace learning (typically six months)

The document discusses the planning and implementing of WIL, and each of the four methodologies listed above is discussed in detail in terms of curriculum, pedagogy, student

learning, assessment, and workplace involvement and considerations. It also includes many illustrative case studies.
The details of the document are:
Work-Integrated Learning: Good Practice Guide
HE Monitor No.12, August 2011, Council on Higher Education. ISBN 978-1-919856-81-0
Authors: Engel-Hills P, Garraway J, Jacobs C, Volbrecht T and Winberg C 2011

ANNEXURE 4: Level Descriptors

Broadly-defined engineering problems have the following characteristics:

a) require coherent and detailed engineering knowledge underpinning the technology area;
and one or more of:
b) are ill-posed, or under or over specified, requiring identification and interpretation into the technology area;
c) encompass systems within complex engineering systems;
d) belong to families of problems which are solved in well-accepted but innovative ways;
and one or more of:
e) can be solved by structured analysis techniques;
f) may be partially outside standards and codes; must provide justification to operate outside;
g) require information from practice area and source interfacing with the practice area that is incomplete;
h) involves a variety of issues which may impose conflicting needs and constraints; technical, engineering and interested or affected parties.