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BOARD NOTICE

NOTICE 127 OF 2014

Engineering Council of South Africa

Invitation to Comment on the Proposed ECSA Whole Qualification Standard

ECSA

1. Background

The HEQSF-compliant qualification attached was developed in order to fill the gap that was identified in the progression from Technologist to Engineer registration; and to comply with the Policy on Higher Education Qualifications: Oct 2007.

The attached qualification is:

NO.	TITLE	LEVEL	CREDIT(S)	EDUCATIONAL REQUIREMENT
1	Master of Engineering	09	180	Professional Engineer

2. QUALIFICATIONS GENERATION PROCESS

The Engineering Standards Generating Body (ESGB), through the **Standards Generating Group** undertook the work of developing the Master of Engineering Qualification. The Standards Generating Group comprised of an ESGB member as chairperson and 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 a standard that would allow for progression from the technology qualifications, that are aligned to the Revised HEQSF, to a professional qualification.

The proposed standard 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 Master of Engineering standard relies 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 **Thursday 20 November 2014** by e-mail to the ECSA Education Manager, Samantha Naidoo at samantha@ecsa.co.za

ENGINEERING COUNCIL OF SOUTH AFRICA *Standards and Procedures System*			ECSA
Qualification Standard for Master of Engineering: NQF Level 9			
Status: DRAFT			
Document : E-22-P	**Rev 0.2**	**Date: October 2014**	

Background: The ECSA Education System Documents

The documents that define the Engineering Council of South Africa (ECSA) system for accreditation of programmes meeting educational requirements for professional categories are shown in Figure 1 which also locates the current document.

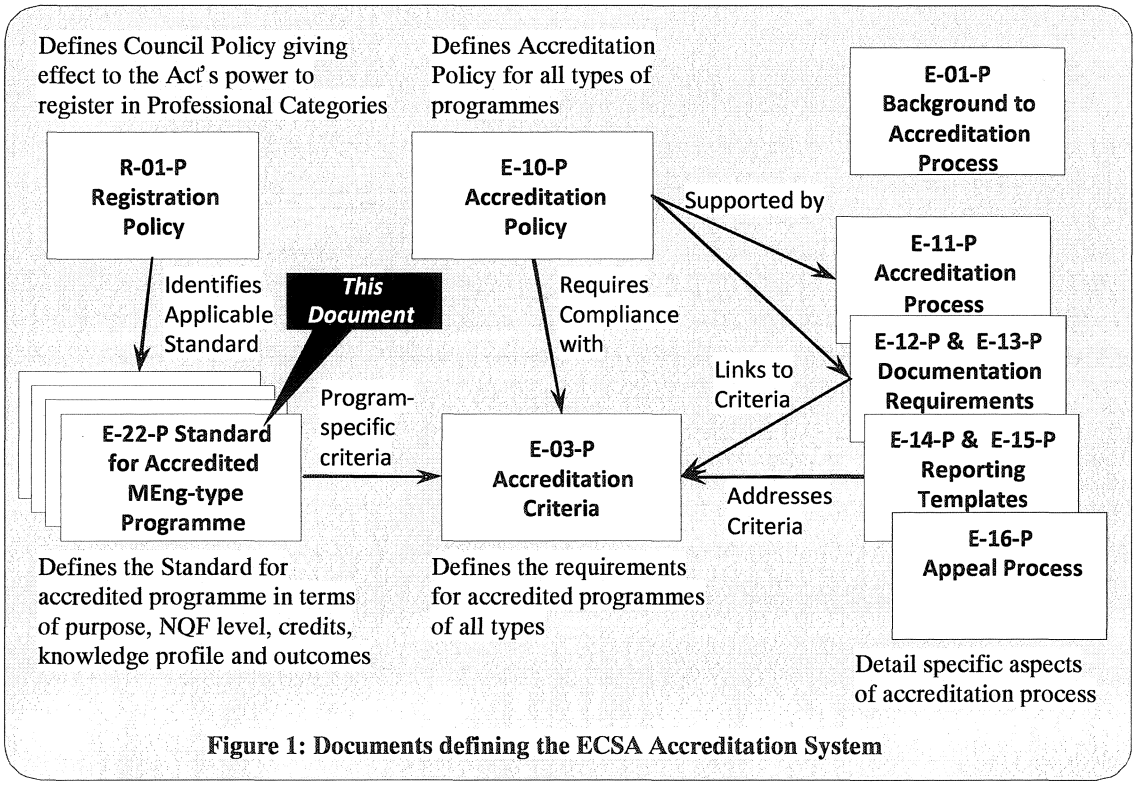

Figure 1: Documents defining the ECSA Accreditation System

1. Purpose

This document defines the standard for accredited Master of Engineering-type programmes meeting the educational requirements for registration as a professional engineer in terms of programme design criteria, a knowledge profile and a set of exit level outcomes. This standard is referred to in the Accreditation Criteria defined in ECSA document E-03-P.

2. HEQSF and NQF Specification

Field: Manufacturing, Engineering and Technology
Sub-Field: Engineering and Related Design
NQF Level: Level 9
Credits: 180 credits total: Not less than 120 Credits shall be at NQF level 9

Acceptable titles: Master of Engineering
Abbreviation: MEng
Qualifiers: See section 3

3. Qualifiers

The *qualification type* is the first name given to a qualification. The *designator* is the second name given to a qualification, to indicate its broad area of study, discipline or profession. The third name given to a qualification type is the *qualifier.*

All Degrees (Bachelor, Master and Doctor) have designators, but designators are not used for certificates and diplomas. The linking word between the qualification type and the designator is *of (e.g.* Master of Engineering), and when abbreviated the 'of' is omitted (e.g. MEng).

The third name given to a qualification type is the *qualifier.* Qualifiers may be used in all qualification types in order to indicate a field of specialisation. The linking word between the qualification type or its designator and the qualifier is always *in* (e.g. Master of Engineering *in* Mechanical Engineering, Abbreviated form: M Eng (*Mechanical*).

In the case of a provider offering programmes with different designations but having only minor differences in content or undifferentiated purposes, only one programme should be accredited.

Examples of acceptable designations in accordance with HEQF policy are:
Master of Engineering in Electrical Engineering, abbreviated MEng (*Electrical*)

4. Purpose of the Qualification

The Master of Engineering degree prepares a candidate for professional practice, enhances in-depth knowledge and understanding of the principles, specialist and contextual knowledge of a branch of engineering, cultivates a critical awareness of developments at the forefront of the field, develops the capacity to conduct research, and meets the minimum entry requirement for admission to a NQF level 10 Doctoral Degree.

This qualification demands a high level of theoretical engagement and intellectual independence. The Master of Engineering together with the Bachelor of Engineering Technology Honours and a Sydney Accord –type degree meeting the educational requirements for registration as a professional engineering technologist (typically a Bachelor of Engineering Technology), *form a combination of qualifications* to meet and exceed the educational requirements for registration as a candidate or professional engineer

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

5. Characteristic Profile of the Graduate:

- Work independently and responsibly, applying original thought and judgment to technical and risk-based decisions in *uncertain* and *complex* situations;

- Have a broad, fundamentals-based appreciation of engineering sciences, with depth in specific areas, together with knowledge of financial, commercial, legal, social and economic, health, safety, environmental and sustainability matters; and
- Professional expertise in a particular discipline and the ability to conduct *research* and perform in-depth engineering investigations to solve *complex* engineering problems.

6. Programme Structure

The programme leading to the qualification shall contain a minimum of 180 credits including a research project of no less than 60 credits at NQF Level 9. Not less than 120 Credits shall be at NQF level 9. Credits shall be distributed in order to create a coherent progression of learning toward the exit level.

7. 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 listed in Table 1.

Table 1: *Minimum* credits in knowledge areas	
Total	≥180
Mathematical and natural Sciences	30
Engineering sciences	30
Engineering design & synthesis	30
Complementary studies	20
Engineering research project	60
Available for re-allocation in above areas	≥10

Note:

The Master of Engineering together with the Bachelor of Engineering Technology Honours and a Sydney Accord –type degree meeting the educational requirements for registration as a professional technologist (typically the Bachelor of Engineering Technology) form a combination of qualifications to meet the educational requirements for registration as a candidate or professional engineer. A *typical* calculation of combined credits are shown in Table 2.

Credits available for reallocation must be assigned to the 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-01-P.

Table 2	BEngTech	BEngTech(Hons)	MEng	Combination
Total	≥420	≥140	≥180	≥740
Mathematics and natural sciences	70	21	30	121
Engineering sciences	140	42	30	212

Engineering design & synthesis	49	28	30	107
Complementary studies	49	14	20	83
Available for re-allocation in the above areas	≥112	≥5	≥10	≥127
Research		30	60	90

8. Core and specialist requirements

The programme must have a coherent core of mathematics, natural sciences and fundamental engineering sciences that provides a viable platform for research and development, 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 must 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.

The Complementary Studies area covers those disciplines outside of engineering sciences, basic sciences and mathematics which are relevant to the practice of engineering.

9. Curriculum Content

This standard does not specify detailed curriculum content but the desired learning outcomes to be achieved. The fundamental and specialist engineering science content must be consistent with the designation of the Degree.

10. Access to Qualification

This standard is specified as a set of exit level outcomes and overall distribution of credits. Providers therefore have the freedom to construct programmes geared to different levels of preparedness of learners, including:

- Use of access programmes for learners who do not meet the minimum requirements; and
- Creating articulation pathways from other qualifications.

11. Minimum Learning Assumed to be in Place

It is assumed that students have completed a Bachelor of Engineering Technology Honours or a substantially equivalent qualification or combination of substantially equivalent qualifications.

12. EXIT LEVEL OUTCOMES

Notes:

Exit level outcomes: The defined exit level outcomes are stated generically and may be assessed in various engineering disciplinary or cross-disciplinary contexts in a provider-based or simulated practice environment. Words and phrases having specific meaning are defined in this document or in ECSA Document E- 01-P [1].

Critical Cross-field Outcomes: Refer to the normative information in Appendix A.

Level Descriptors: *Complex and challenging engineering problems* applicable to the exit level outcomes of this Qualification Standard are characterised by an in-depth fundamental and specialized engineering knowledge; and have one or more of the characteristics:

a) are ill-posed, under- or over specified, or require identification and refinement;
b) are high-level problems including component parts or sub-problems;
c) are unfamiliar or involve infrequently encountered issues;
and their solution have one or more of the characteristics:
d) are not obvious, require originality or analysis based on fundamentals;
e) are outside the scope of standards and codes;
f) require information from variety of sources that is complex, abstract or incomplete; and
g) involve wide-ranging or conflicting issues: technical, engineering and interested or affected parties.

This qualification also includes conducting and reporting research under supervision, worth at least 60 credits at NQF Level 9, in the form of a research project appropriate to the discipline or field of study, characterised by:

a) the ability to conduct in depth literature searches;
b) the ability to identify, locate and obtain required data;
c) the ability to design and conduct analytic, modelling and experimental investigations;
d) the ability to critically evaluate data and draw conclusions;
e) the ability to investigate the application of new and emerging technologies in their branch of engineering; and
f) the ability to report and communicate findings.

General Range Statement: The competencies defined in the exit-level outcomes may be demonstrated in a university-based, simulated workplace context. Competencies stated generically may be assessed in various engineering disciplinary or cross-disciplinary contexts.

Exit-level Outcome 1: Problem solving

Use a wide range of specialist skills to identify, conceptualise, design and implement methods of enquiry to solve *complex* and *challenging* engineering problems creatively and innovatively with an understanding of the consequences of any solutions or insights generated within a specialised context.

Level descriptor: Problems are characterized by some or all of the following attributes:

- Require identification and analysis, and may be concrete or abstract, may be divergent and may involve significant uncertainty;
- May be infrequently encountered types and occur in unfamiliar contexts;
- Approach to find solutions is creative and innovative;
- Information is complex and possibly incomplete, requiring validation and critical analysis;
- Solutions are based on theory, use of first principles and evidence, (which may be incomplete) together with judgment where necessary; and
- Involves a variety of interactions which may impose conflicting constraints, premises, assumptions and / or restrictions.

Exit-level Outcome 2: Application of scientific and engineering knowledge

Apply specialist knowledge of mathematics, natural science and engineering sciences to solve *complex engineering problems*, conceptualize models and enable engagement with and critique of current and emerging research and practices.

Level descriptor: Knowledge of mathematics, natural science and engineering sciences is characterized by:

- Knowledge of mathematics using formalism, and oriented toward engineering analysis and modeling; deep knowledge of natural sciences: both as relevant to discipline;
- Deep knowledge of a broad range of fundamental principles of an engineering discipline or cross-disciplinary field that is coherently and systematically organized;
- In-depth, theoretically based knowledge in limited specialist area(s), informed by current developments, and emerging issues and
- The use of mathematics, naturals science and engineering sciences in formal analysis and modeling of engineering situations, for reasoning about and conceptualizing complex engineering problems.

Note: Problems used for assessment may provide evidence in the application of one, two or all three categories of knowledge listed above. It also requires working across engineering disciplinary boundaries through cross disciplinary literacy and shared fundamental knowledge.

Range Statement: Mathematics, natural science and engineering sciences are applied in formal analysis and modelling of engineering situations, and for reasoning about and conceptualizing engineering problems.

Exit-level Outcome 3: Engineering Design

Perform creative, procedural and non-procedural design and synthesis of components, systems, engineering works, products or processes, demonstrate the ability to propose interventions at an appropriate level within a system based on an understanding of interdependent relations *and* address intended and unintended consequences of interventions.

Range Statement: Design problems used in exit-level assessment must conform to the definition of a complex engineering problems. A major design problem should be used to provide evidence. The design knowledge base and components, systems, engineering works, products or processes to be designed are dependent on the discipline or practice area.

Exit-level Outcome 4: Research, investigations, experiments and data analysis

Demonstrate competence to conduct research, execute detailed technical investigations, implement strategies for the processing and management of information, including the review of current advances in the field, to produce new insights and solve *complex* engineering problems

Range Statement: The balance of investigation and experiment should be appropriate to the discipline. Research methodology to be applied in research or investigation where the student engages with selected knowledge in the research literature of the discipline.

Note: An investigation differs from a design in that the objective is to produce knowledge and understanding of a phenomenon and a recommended course of action rather than specifying how an artifact could be produced.

Exit-level Outcome 5: Engineering methods, skills and tools, including information technology

Demonstrate competence to develop, select and apply appropriate and creative techniques, resources, and modern engineering tools, including information technology, prediction and modelling, for the solution of *complex engineering problems*, with an understanding of the limitations, restrictions, premises, assumptions and constraints.

Range Statement: A range of methods, skills and tools appropriate to the disciplinary designation of the program including:

- Discipline-specific tools, processes or procedures including those for assessing and promoting sustainability.
- Computer packages for computation, modelling, simulation, and information handling;
- Computers and networks and information infrastructures for accessing, processing, managing, and storing information to enhance personal productivity and teamwork;

Exit-level Outcome 6: Professional and technical communication

Demonstrate an ability to use the resources of academic, professional and occupational discourses to communicate and defend substantial ideas that are products of research, investigation or development in an area of specialization; and a range of advanced and specialized skills and discourses appropriate to the field, discipline or practice, to communicate to a range of audiences with different levels of knowledge or expertise.

Range Statement: Material to be communicated is in an academic or simulated professional context. Audiences range from engineering peers, management and lay persons, using appropriate academic or professional discourse. Written reports range from short (300-1000 word plus tables diagrams) to a substantial research project of 60 or more credits at NQF level 9, 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: Sustainability and the impact of engineering activity

Demonstrate critical awareness of the sustainability and impact of engineering activity on the social, industrial and physical environment.

Range Statement: The combination of social, workplace (industrial) and physical environmental factors must be appropriate to the discipline or other designation of the qualification. Comprehension of the role of engineering in society and identified issues in engineering prac-

tice 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

Exit-level Outcome 8: Individual, team and multidisciplinary working

Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments.

Range Statement: Multidisciplinary tasks require co-operation across at least one disciplinary boundary. Co-operating disciplines may be engineering disciplines with different fundamental bases other than that of the programme or may be outside engineering.

Exit-level Outcome 9: Independent learning ability

Demonstrate the ability to develop own learning strategies to sustain independent learning and academic and professional development, including effective interaction within the learning or professional group as a means of enhancing learning.

Range Statement: Operate independently in complex, ill-defined contexts requiring personal responsibility and initiative, accurately self-evaluate and take responsibility for learning requirements; be aware of social and ethical implications of applying knowledge in particular contexts.

Exit-level Outcome 10: Engineering professionalism

Demonstrate critical awareness of the need to act professionally and ethically, to exercise judgment and take responsibility within own limits of competence and where appropriate to account for leading and initiating processes and implementing systems, ensuring good resource and governance practices.

Range Statement: Evidence includes case studies typical of engineering practice situations in which the graduate is likely to participate. The contextual knowledge profile specified in the range statement of Exit Level outcome 7 is applicable here.

Exit-level Outcome 11: Engineering Management

Demonstrate knowledge and understanding of engineering management principles and economic decision making.

Range Statement: Basic techniques from economics, business management and project management applied to one's work, as a member and a leader of a team, to manage projects in multidisciplinary environments.

13. International Comparability

This standard has been intentionally written for the combination of the Bachelor of Technology Honours and Master of Engineering (Professional Practice) to meet or exceed the requirements of the European Network for the Accreditation of Engineering Education (ENAEE) Second Cycle (i.e. Master's level) EUR-ACE Framework Standard used for the accreditation of Professional Engineering Programmes in European (Bologna Accord signatory) countries (http://www.enaee.eu)

International comparability of engineering education qualifications is ensured through the Washington and Sydney Accords, all being members of the International Engineering Alliance (IEA).

The exit level outcomes and level descriptors defined in this qualification are aligned with the International Engineering Alliance's Graduate Attributes and Professional Competencies for professional engineers (See www.ieagreements.org).

14. Integrated Assessment

Providers of programmes shall in the quality assurance process demonstrate that an effective integrated assessment strategy is used. Clearly identified components of assessment must address summative assessment of the exit level outcomes. Evidence should be derived from major work or multiple instances of limited scale work.

15. 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.

16. Articulation Possibilities

A Master's degree at NQF Level 9 meets the requirements for admission to a Doctoral degree at NQF Level 10. A qualification may not be awarded for early exit from a Master of Engineering degree.

17. Moderation and Registration of Assessors

Providers of programmes shall in the quality assurance process demonstrate that an effective moderation process exists to ensure that the assessment system is consistent and fair.

Appendix A: Consistency of Exit Level Outcomes with Critical Crossfield Outcomes

SAQA Critical Cross-Field Outcomes	Equivalent Exit Level Outcome
Identifying and solving problems in which responses display that responsible decisions using critical thinking have been made.	ELO 1, 2, 3, 5

Working effectively with others as a member of a team, group, organization and community.	ELO 8, 11
Organising and managing oneself and one's activities responsibly and effectively	ELO 8, 11
Collecting, analyzing, organizing and critically evaluating information.	ELO 1, 3, 5
Communicating effectively using visual, mathematical and/or language skills	ELO 2, 6
Using science and technology effectively and critically, showing responsibility toward the environment and health of others	ELO 2, 3, 4, 5, 7, 11
Demonstrating an understanding of the world as a set of related systems by recognizing that problem contexts do not exist in isolation	ELO 1, 3,
Contributing to the full personal development of each learner and the social and economic development of society at large, by making it an underlying intention of the programme of learning to make an individual aware of:	
• reflecting on and exploring a variety of strategies to learn more effectively	ELO 9
• participating as responsible citizens in the life of local, national and global communities	ELO 10, 11
•being culturally and aesthetically sensitive across a range of contexts	ELO 7
• exploring education and career opportunities	ELO 8
• Developing entrepreneurial opportunities	ELO 3

Revision History

Version	Date	Revision Authorized by	Nature of revision

NOTICE – CHANGE OF TELEPHONE NUMBERS: GOVERNMENT PRINTING WORKS

As the mandated government security printer, providing world class security products and services, Government Printing Works has adopted some of the highly innovative technologies to best serve its customers and stakeholders. In line with this task, Government Printing Works has implemented a new telephony system to ensure most effective communication and accessibility. As a result of this development, our telephone numbers will change with effect from 3 February 2014, starting with the Pretoria offices.

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