Qualification Standard for Bachelor of Science in Engineering (BSc(Eng))/ Bachelors of Engineering (BEng): NQF Level 8

E-02-PE

REVISION NO. 5: 17 April 2019
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DEFINITIONS

Complementary Studies: cover those disciplines outside of engineering sciences, natural sciences and mathematics which are relevant to the practice of engineering including but not limited to engineering economics, management, the impact of technology on society, effective communication, and the humanities, social sciences or other areas that support an understanding of the world in which engineering is practised.

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 fundamentals: engineering sciences that embody 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 Discipline (=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.

Engineering Sciences: 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 engineering applications and solve engineering problems.

Engineering Speciality: the extension of engineering fundamentals to create theoretical frameworks and bodies of knowledge for engineering practice areas.

Mathematical Sciences: an umbrella term embracing the techniques of mathematics, numerical analysis, statistics and aspects of computer science cast in an appropriate mathematical formalism.
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.
BACKGROUND

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.

![Diagram](image)

**Figure 1: Documents defining the ECSA Accreditation System**

1. PURPOSE OF THIS DOCUMENT

This document defines the standard for accredited Bachelor of Engineering-type programmes in terms of programme design criteria, a knowledge profile and a set of graduate attributes. This standard is referred to in the Accreditation Criteria defined in ECSA document **E-03-P**.

2. FIELD

Manufacturing, Engineering and Technology
3. SUBFIELD
Engineering and Related Design

4. NQF EXIT LEVEL
Level 8

5. CREDITS
At least 560 credits. Not less than 120 Credits must be at NQF level 8.

6. ACCEPTABLE TITLES
Bachelor of Engineering, Bachelor of Science in Engineering, Baccalareus Ingeneriae

7. ABBREVIATIONS
BEng, BSc(Eng), Blng.

8. QUALIFIERS
The qualification must have a disciplinary or cross-disciplinary qualifier (discipline, branch, option or endorsement) defined in the provider’s rules for the degree that is reflected on the academic transcript and degree certificate, subject to the following:

8.1. 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, Information, Materials, Mechanical, Mechatronic, Metallurgical, Mineral(s) Process, Physical Metallurgical and Mining. Qualifiers are not restricted to this list.

8.2. The qualifier(s) must clearly indicate the nature and purpose of the programme.

8.3. The qualifier must be consistent with the fundamental engineering science content on the programme.

8.4. The qualifier(s) should be comparable with typical programmes within Washington Accord countries.

8.5. The target market indicated by the qualifier may be a traditional branch of engineering or a substantial industry area. Programmes should not address narrow niche markets.
Formal education for such markets should rather be satisfied by broad undergraduate programmes such as specified in this standard followed by specialized course-based postgraduate programmes.

In the case of a provider offering programmes with the same first-level qualifier and different second level qualifications but with insufficiently differentiated purpose or content, only one programme should be accredited.

Examples of acceptable designations in accordance with HEQF policy are:
Bachelor of Engineering in Civil Engineering, abbreviated BEng (Civil Engineering)
Bachelor of Engineering in Civil Engineering in Environmental Engineering abbreviated BEng (Civil Engineering) (Environmental Engineering)

9. PURPOSE OF THE QUALIFICATION
The purpose of the qualification is to build the necessary knowledge, understanding, abilities and skills required for further learning towards becoming a competent practicing engineer. The recognised purpose of this bachelor's degree in engineering, accredited as satisfying this standard is to provide graduates with:

9.1. Preparation for careers in engineering and related areas, for achieving technical leadership and to make a contribution to the economy and national development;

9.2. The educational requirement towards registration as a Professional Engineer with the Engineering Council of South Africa as well as to allow the graduate to pursue careers in engineering and related fields;

9.3. A thorough grounding in mathematics, natural sciences, engineering sciences, engineering modelling, engineering design and the ability to enable applications in fields of emerging knowledge together with an appreciation for the world and society in which engineering is practiced;

9.4. For graduates with an appropriate level of achievement in the programme, the ability to proceed to postgraduate studies in both course-based and research masters programmes.
10. PROGRAMME STRUCTURE

Subject to the overall requirement for a minimum of 560 credits determined using the method defined in document R-01-P with not less than 120 credits at NQF level 8, credits must be distributed in order to create a coherent progression of learning towards the exit-level. Preparatory or remedial courses are not included in the 560 credits.

10.1. Knowledge Areas in the Programme

The content of the programme when analysed by knowledge area must not fall below the minimum SAQA credits in each knowledge area in table 1.

Knowledge areas are defined in document E-01-P. The method for calculating credits and allocating to knowledge areas is defined in document E-01-P.

Table 1: Minimum curriculum content by knowledge area

<table>
<thead>
<tr>
<th>Knowledge area</th>
<th>Minimum Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematical Sciences</td>
<td>56</td>
</tr>
<tr>
<td>Natural Sciences</td>
<td>56</td>
</tr>
<tr>
<td>Engineering Sciences</td>
<td>180</td>
</tr>
<tr>
<td>Design and Synthesis</td>
<td>72</td>
</tr>
<tr>
<td>Complementary studies</td>
<td>56</td>
</tr>
<tr>
<td>Subtotal</td>
<td>420</td>
</tr>
<tr>
<td>For Reallocation</td>
<td>≥140</td>
</tr>
<tr>
<td>Total Credits</td>
<td>≥560</td>
</tr>
</tbody>
</table>

The for reallocation component must be taken up by allocating knowledge to the five knowledge areas to form a coherent, balanced programme.
If the provider includes work-based learning in the programme, credits may be assigned and included in the knowledge breakdown only if the work is quality-assured by the provider, the students’ performance is comprehensively assessed against defined outcomes, and if this information is documented and presented in the accreditation process.

10.2. Core and Specialist Requirements
The programme must have a coherent core of mathematics, natural sciences and engineering fundamentals 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.
A programme must contain specialist engineering study at the exit-level. 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.

10.3. Curriculum Content
This standard does not specify detailed curriculum content. The engineering fundamentals and specialist engineering science content must be consistent with the designation of the degree.

11. ACCESS TO QUALIFICATION
This standard is specified as a set of graduate attributes and overall distribution of credits. Providers therefore have 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 learning requirements;
- Creating articulation paths from other qualifications.

12. MINIMUM LEARNING ASSUMED TO BE IN PLACE
Designers of a 560 credit programme to meet the graduate attributes and credit requirements defined in this standard assume that entrants are proficient as specified by the provider’s entry
requirements in Mathematics, Physical Science and reading, speaking and writing in the language of teaching and learning, and reading in English.

**Note:** These assumptions do not prescribe prerequisites. Sections 11 and 12 should be read together.

### 13. GRADUATE ATTRIBUTES

The graduate attributes 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. Words and phrases having specific meaning are defined in this document or in ECSA Document E-01-P [1].

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

**Level Descriptor: Complex engineering problems:**

a) require in-depth fundamental and specialized engineering knowledge; and have one or more of the characteristics:

i) are ill-posed, under- or over specified, or require identification and refinement;  
ii) are high-level problems including component parts or sub-problems;  
iii) are unfamiliar or involve infrequently encountered issues;  

b) and their solutions have one or more of the characteristics:  

i) are not obvious, require originality or analysis based on fundamentals;  
ii) are outside the scope of standards and codes;  
iii) require information from variety of sources that is complex, abstract or incomplete;  
iv) involve wide-ranging or conflicting issues: technical, engineering and interested or affected parties.

**Graduate Attribute 1: Problem solving**
Identify, formulate, analyse and solve complex engineering problems creatively and innovatively.

Graduate Attribute 2: Application of scientific and engineering knowledge
Apply knowledge of mathematics, natural sciences, engineering fundamentals and an engineering speciality to solve complex engineering problems.

Level descriptor: Knowledge of mathematics, natural sciences and engineering sciences is characterized by:
- A systematic, theory-based understanding of the natural sciences applicable to the discipline;
- Conceptually-based mathematics, numerical analysis, statistics and formal aspects of computer and information science to support analysis and modelling applicable to the discipline;
- A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline; and
- 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.

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.

Graduate Attribute 3: Engineering design
Perform creative, procedural and non-procedural design and synthesis of components, systems, engineering works, products or processes.

Range Statement: Design problems used in exit-level assessment must conform to the definition of a complex engineering problem. 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.
Graduate Attribute 4: Investigations, experiments and data analysis

Demonstrate competence to design and conduct investigations and experiments.

**Range Statement:** The balance of investigation and experiment should be appropriate to the discipline. Research methodology is to be applied in research or an 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.

Graduate Attribute 5: Engineering methods, skills and tools, including information technology

Demonstrate competence to use appropriate engineering methods, skills and tools, including those based on information technology.

**Range Statement:** A range of methods, skills and tools appropriate to the disciplinary designation of the program including:
- Discipline-specific tools, processes or procedures;
- 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.

Graduate Attribute 6: Professional and technical communication

Demonstrate competence to communicate effectively, both orally and in writing, with engineering audiences and the community at large.

**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 words plus tables 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.

Graduate Attribute 7: Sustainability and 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 practice in the discipline: health, safety and environmental protection; risk assessment and management and the impacts of engineering activity: economic, social, cultural, environmental and sustainability.

Graduate Attribute 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.

Graduate Attribute 9: Independent learning ability

Demonstrate competence to engage in independent learning through well-developed learning skills.

**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.

Graduate Attribute 10: Engineering professionalism

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Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

**Range Statement:** Evidence includes case studies typical of engineering practice situations in which the graduate is likely to participate. Ethics and the professional responsibility of an engineer and the contextual knowledge specified in the range statement of Graduate Attribute 7 is generally applicable here.

**Graduate Attribute 11: Engineering management**

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

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

14. INTERNATIONAL COMPARABILITY

International comparability of this whole qualification standard is ensured through the Washington Accord, an agreement for the mutual recognition of professionally-oriented bachelor’s degrees in engineering. The standards are comparable with the Washington Accord Graduate Attributes. Washington Accord signatories are: Australia, Canada, Chinese Taipei, Hong Kong China, India, Ireland, Japan, Republic of Korea, Malaysia, Russia, New Zealand, Singapore, South Africa, Sri Lanka, Turkey, United Kingdom, United States of America, Peru and Pakistan*. Comparability is audited on a six-yearly cycle by a visiting Washington Accord team.

* **N.B. The number of signatories to the Washington Accord is subject to change as new members meeting the requirements are registered.**

15. INTEGRATED ASSESSMENT

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

16. RECOGNITION OF PRIOR LEARNING
Providers may make use of recognition of prior learning at intermediate levels but must take full responsibility for assessing the graduate attributes.

17. ARTICULATION POSSIBILITIES
The graduate attributes ensure that a graduate of a programme meeting these standards would meet requirements for entry to a number of programmes including:

17.1. A candidacy programme toward registration as a Professional Engineer;
17.2. Formal specialist study toward Postgraduate Diplomas;
17.3. A postgraduate Bachelor of Laws (LLB) programme;
17.4. Specialist coursework masters programmes;
17.5. Research masters programmes leading to masters degrees with or without coursework components;
17.6. With appropriate work experience, a Master of Business Administration or similar;
17.7. In certain disciplines, progression toward the Government Certificate of Competency.

18. MODERATION AND REGISTRATION OF ASSESSORS
Providers of programmes must demonstrate in the quality assurance process that an effective moderation process exists to ensure that the assessment system is consistent and fair.

Registration of assessors is delegated by the Higher Education Quality Committee to the Higher Education providers responsible for programmes.

References
1. Background to Accreditation of Engineering Education Programmes, Document E-01-P.
Available via www.ecsa.co.za.
Subject: Qualification Standard for Bachelor of Science in Engineering (BSc(Eng))/Bachelors of Engineering (BEng): NQF Level 8

Compiler: MB Mtshali
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Next Review Date: 17/04/2023

### REVISION HISTORY

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<td>16 April 1998</td>
<td>Initial Issue</td>
<td>Council</td>
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<td>Rev-1/Draft A</td>
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<td>Change to SAQA Credit (3.1) Editorial changes</td>
<td>UAC: Recommended to Council</td>
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<td>Rev-1</td>
<td>11 Aug 2000</td>
<td>Put into PDF format</td>
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<td>Revision 2</td>
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<td>Council, approved by SAQA, registered on NQF</td>
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<td>Revision 2.1</td>
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<td>Acc Policy WG</td>
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<td>Rev 3/Draft B</td>
<td>25 Oct 2007</td>
<td>Incorporates changes approved by SGG for confirmation by SGG</td>
<td>BEng SGG</td>
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<tr>
<td>Rev 3/ Draft C</td>
<td>15 Sep 2011</td>
<td>HEQF Alignment, Assessment criteria changed to informative, Graduate Attribute Alignment</td>
<td>EPAC</td>
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<td>Rev 3 / Draft D</td>
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<td>Corrections and expansion of explanatory notes for circulation to stakeholders.</td>
<td>EPAC and ESGB</td>
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<td>21 June 2012</td>
<td>For approval by Council</td>
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<td>Rev 4 – Draft A</td>
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The Standard for:

Qualification Standard for Bachelor of Science in Engineering (BSc(Eng))/ Bachelors of Engineering (BEng): NQF Level 8

Revision 5 dated 17 April 2019 and consisting of 17 pages has been reviewed for adequacy by the Business Unit Manager and is approved by the Executive: Research Policy and Standards (RPS).

![Business Unit Manager Signature]

Date: 24/07/2019

![Executive Signature]

Date: 26/07/2019

This definitive version of this policy is available on our website.
### Appendix A: Consistency of Graduate Attributes with Critical Crossfield Outcomes

<table>
<thead>
<tr>
<th>SAQA Critical Cross-Field Outcomes</th>
<th>Equivalent Graduate Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifying and solving problems in which responses display that responsible decisions using critical thinking have been made.</td>
<td>GA 1, 2, 3, 5</td>
</tr>
<tr>
<td>Working effectively with others as a member of a team, group, organisation and community.</td>
<td>GA 8</td>
</tr>
<tr>
<td>Organising and managing oneself and one’s activities responsibly and effectively.</td>
<td>GA 8</td>
</tr>
<tr>
<td>Collecting, analysing, organising and critically evaluating information.</td>
<td>GA 1, 3, 5</td>
</tr>
<tr>
<td>Communicating effectively using visual, mathematical and/or language skills.</td>
<td>GA 2, 6</td>
</tr>
<tr>
<td>Using science and technology effectively and critically, showing responsibility toward the environment and health of others.</td>
<td>GA 2, 3, 4, 5, 7</td>
</tr>
<tr>
<td>Demonstrating an understanding of the world as a set of related systems by recognizing that problem contexts do not exist in isolation.</td>
<td>GA 1, 3, 5</td>
</tr>
<tr>
<td>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:</td>
<td>GA 9, 10, 7, 8, 11</td>
</tr>
<tr>
<td>• reflecting on and exploring a variety of strategies to more effectively learn</td>
<td>GA 9</td>
</tr>
<tr>
<td>• participating as responsible citizens in the life of national and global communities local</td>
<td>GA 10</td>
</tr>
<tr>
<td>• being culturally and aesthetically sensitive across a of contexts range</td>
<td>GA 7</td>
</tr>
<tr>
<td>• exploring education and career opportunities</td>
<td>GA 8</td>
</tr>
<tr>
<td>• Developing entrepreneurial opportunities</td>
<td>GA 3</td>
</tr>
</tbody>
</table>