Guidelines on Engineering Programme Design in Alignment with European Qualifications Frameworks, European Standards for Accreditation of Engineering Programmes and the Southern African Quality and Accreditation Standards

(Work-package 1.3 in the Edulink’s PEESA project)

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Berlin, Jena, January 2017
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List of Abbreviations

AAC&U: Association of American Colleges and Universities
ABET: American Board of Engineering and Technology
ASIIN: Accreditation Agency for Degree Programs in Engineering, Informatics, the Natural Sciences and Mathematics
CDIO: Conceive, Design, Implement, Operate
CESM: Classification of Educational Subject Matter
CHE: South Africa, Council of Higher Education
CHEA: USA Council of Higher Education Accreditation
CPUT: Department of Higher Education & Training
EAFSG: EUR-ACE Framework Standards and Guidelines
ECTS: European Credit Transfer System
ECSA: Engineering Council of South Africa
EHEA: European Higher Education Area
ENAEE: European Network for Accreditation of Engineering Education
EAH Jena: Ernst-Abbe-Hochschule Jena
ELO: Exit Level Outcome
EQF: European Qualifications Framework
EQF-LLL: European Qualifications Framework for Life-Long Learning
EQAR: European Quality Assurance Register
ESG: European Standards and Guidelines for Quality Assurance in the European Higher Education Area
ESU: European Students’ Union
EUR-ACE: European Accreditation of Engineering Programmes
EUA: European University Association
HEI: Higher Education Institution
HEQC: Higher Education Quality Committee
HEQSF: Higher Education Qualification Sub-Framework
GFETQSF: General and Further Education and Training Sub-Framework
IEA: International Engineering Alliance
ILO: Intended Learning Outcome
IPD: Initial Professional Development
LLL: Lifelong learning
LTSN: Learning and Teaching Support Network
ND: National Diploma
NQF: National Qualifications Framework
OBTL: Outcome Based Teaching and Learning
OECD: Organisation for Economic Co-operation and Development
OQSF: Occupational Qualifications Sub-Framework
PE: Professional Engineer
PEESA: Programme on Energy Efficiency in Southern Africa
PEOs: Programme Educational Objectives
PISA: Programme for International Student Assessment
PoN/NUST: Polytechnic of Namibia/Namibia University of Science and Technology
PQM: Programme and Qualification Mix
REEE: Renewable Energy and Energy Efficiency
RPL: Recognition of Prior Learning
QM: Quality Management
QF-EHEA: Qualifications Framework of the European Higher Education Area
SA: South Africa
SAQA: South African Qualifications Authority
SCD: Second Cycle Degree
SOs: Student Outcomes
**TUNING:** Tuning educational structures in Europe

**TUT:** Tshwane University of Technology

**UK:** United Kingdom

**USA:** United States of America

**VALUE:** Valid Assessment of Learning in Undergraduate Education

**VET:** Vocational Education and Training

**VUT:** Vaal University of Technology

**WIL:** Work integrated learning
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Introduction

The main aim of the EDULINK’s II project “Programme on Energy Efficiency in Southern Africa” (PEESA), carried out from October 2014 to March 2017, was the design and implementation of engineering master degree programmes in renewable energy and energy efficiency at

- the Polytechnic of Namibia (PoN), since August 2015 Namibia University of Science and Technology (NUST) and

- three Universities of Technology in South Africa:
  - Cape Peninsula University of Technology (CPUT),
  - Tshwane University of Technology (TUT) and
  - Vaal University of Technology (VUT).

European partners in the PEESA project have been represented by three German Universities of Applied Sciences

- from Wismar (contractor and main coordinator),
- Jena and
- Flensburg.

In addition, the European Network for the Accreditation of Engineering Education (ENAAEE), represented by the German accreditation agency ASIIN joined the PEESA project as an associated partner. The inclusion of ENAEE into the PEESA consortium resulted from the intention to design the programmes not only with regard to the national qualifications frameworks and professional standards but also, as much as possible, with reference to European standards:

- the European Qualifications Frameworks (EQF),
- the ENAEE EUR-ACE Standards and Guidelines for the Accreditation of Engineering Programmes and
- the European Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG).

This approach shall facilitate the international recognition of the envisaged qualifications and the collaboration on joint programmes as well as student and staff exchange with foreign...
universities. An additional option shall be the application for a professional EUR-ACE Master label accreditation at an ENAEE authorised European agency such as the German ASIIN.

Therefore, one initial task of the PEESA project was to analyse and assess to what extent South African and Namibian qualification standards and master programme formats are comparable or even equivalent to European standards and programmes. The results are documented in the first part of the PEESA project outcome.

The second step was devoted to the discussion and adoption of a systematic and comprehensive approach for programme design with reference to the required standards and intended learning outcomes.

Professional programme accreditation does not require or prescribe a certain approach to curriculum design and implementation as it is primarily based on the achievements of certain required programme and learning outcomes and the provision of satisfactory evidence to external evaluators. However, a systematic and comprehensive approach normally facilitates necessary national approval and accreditation procedures as well as a future external professional accreditation. It also contributes to an effective and efficient internal quality management and continuous improvement.

For practical reasons, the project partners decided not to define a new PEESA specific approach to engineering study programme design but to rely on already existing concepts, procedures and documents in South Africa and Namibia and internationally. However, the outcomes based curriculum development process should be guided by theoretical concepts like “constructive alignment” and “backward design” as

- described by presentations of Guenter Heitmann and Jan Smit during the first PEESA workshop in Windhoek in May 2014 as well as

- illustrated by practical examples such as
  
  - the ABET – two loop approach,
  - the CDIO criteria,
  - the European TUNING project and
  - examples from the partner universities in South Africa and Namibia.

This is described and illustrated in the second chapter of this publication.
The final activity was devoted to the development of guidelines and instructions for programme design addressing the various steps of systematic programme design. Results and useful forms are presented and discussed in Chapter 3 of this publication, including also the instructions and hand-outs for curriculum development which have been distributed in the beginning of the PEESA project.

Primarily, design and implementation of the envisaged Master programmes have to satisfy the national and local requirements and conditions. The assumption was that by this approach most of the requirements of a future ENAEE EUR-ACE accreditation will also be matched. This assumption had to be proved. In case of divergence or of additional requirements caused by ENAEE EUR-ACE standards and guidelines it should be taken into account.

Therefore, in the following guidelines and instructions for programme design and curriculum development and implementation we followed the various steps of the Vaal University of Technology (VUT) flow chart and checked which kind of forms and information from different sources are helpful, including the EUR-ACE Framework Standards and Guidelines (EAFSG) and Engineering Council South Africa (ECSA) requirements.

Besides, supporting the programme design and implementation in the PEESA project in the area of energy efficiency and facilitating a future professional accreditation, these guidelines can in general be used for curriculum development and course planning in engineering education and related disciplines.
1 Context of Programme Design and Accreditation in Higher Education in Europe and Southern Africa

1.1 Recent Changes of Higher Education in Europe and Southern Africa

Higher Education in Europe including engineering education since 2000 has been challenged by new transnational political aims and measures resulting from the Bologna Declaration of 1999 and the subsequent Bologna Process. The latter was organised to specify the aims of the Bologna Declaration by respective measures and to facilitate and monitor their realisation, initially terminated to 2010.

The Bologna Declaration started a coordinated activity to establish a common European Higher Education Area (EHEA) by meanwhile 47 signatory countries in order to increase transparency, mobility and mutual recognition and to enhance quality and competiveness. By identifying 10 different action lines and measures, the Bologna Process aimed to achieve this target and to implement a common and flexible three cycle structure of higher education including a common European Credit Transfer System (ECTS) and shared approaches to quality assurance by 2010.

For many national higher education systems and in particular for traditional continental European universities with integrated programmes of study of 5 to 6 years duration leading to a degree that was equivalent to a master degree with a strong research profile, the implementation of an additional degree level after 3 to 4 years of study seemed to be the most demanding challenge. As the Bologna Declaration and Process was just an agreement concerning certain aims and action lines between the signatory countries but with no legal power supporting it, some countries initially did not fully implement the recommended measures and tools. However, by 2013 the majority of the signatory countries of the Bologna Process had changed their systems to a three cycle structure. Nevertheless, despite the common structure, the diversity in Europe increased and the mobility and recognition aims have not been achieved to the extent initially expected. The monitoring and stock-taking of the Process and the discussions at the Bologna Seminars and Follow-up Conferences highlighted the fact that more time will be needed to implement some developments such as the shift towards learning outcomes and agreed standards of quality and for programmes to be enriched by additional aspects and conditions such as the inclusion of the social dimension.
The Bologna Process was therefore extended to 2020, with ongoing stock-taking, seminars and follow-up conferences.

In general the three cycle system of higher education, including the third cycle Doctorate Level, is the predominant structure. In addition, many countries offer sub-degree programmes of usually two years’ duration, which in other countries would be part of the Vocational Education and Training (VET) system. The Bologna Process, with the implementation of the three cycle structure, presented a challenge to those continental European universities, which traditionally offered integrated programmes of 5 or 6 years duration, directly leading to a Second Cycle Degree (SCD), which was equivalent to a master degree, but was differently named in different countries.

This structure also applies to Engineering Education, apart from integrated programmes at more practice oriented HEIs which award an engineering degree after 3 to 4 years of study. With reference to the agreed Bologna structure the signatory countries adopted different approaches. Some countries immediately adopted the new structure (e.g. Italy), while others continued for some time to provide the old system in parallel to the new one (e.g. Germany). In engineering education a number of European countries continue to offer their traditional programmes (e.g. France and Sweden), often accompanied by highly specialised short “master” programmes as part of continuing education. The UK sticks to integrated programmes introduced in the nineties in parallel to sequenced programmes. They partly replaced bachelor honours programmes and directly lead to a MEng degree after 4 years of study, claimed to be a second cycle Bologna qualification.

The new Bologna first cycle degree after three to four years of study and the achievement of 180 to 240 ECTS credits should prepare graduates for the labour market and guarantee their employability. Globally this first degree, usually after 4 years of study, is the regular entrance qualification into engineering practice and is sometimes linked to additional requirements concerning practical experiences in a phase of “Initial Professional Development” (IPD) and an exam in order to become a registered or licenced “Professional Engineer” (PE).

Many of the traditional European research universities with 5 or 6 year integrated programmes in engineering education did not welcome the new structure, and they still expect the majority of their students to continue to a Second Cycle Degree (SCD), in terms of Anglo-American systems a post-graduate degree. They perceive the newly introduced First Cycle Degree level as a kind of distribution or pivot point towards a differentiated second cycle
programme level. They appreciate this new second cycle level because of its potential to allow a diversification of the programme offerings at graduate level and to attract national and international students who already carry an appropriate first degree. Some of the European research universities try to enroll more students at the graduate rather than at the undergraduate level.

In addition to the structural changes HEIs were advised to use Qualifications Framework level indicators and learning outcomes, as outlined in the Framework for Qualifications of the European Higher Education Area (FQ-EHEA), as reference for curriculum development and quality assurance. Associated with the shift to learning outcomes was the requirement to introduce a common European Credit Transfer and Accumulation System (ECTS) based on student workload, but also related to outcomes for different levels of programmes. The study workload should not be expressed by student contact hours with teaching staff, like for instance in the USA credit system, but by the total time of all learning activities necessary for an average student to achieve certain outcomes of a module or course unit. This approach of calculating the total learning time of the “average student” is highly speculative. Only in an iterative process of continuous adjustment, based on student feedback and data collection, the teaching staff can arrive at valid and reliable figures with regard to their lectures and modules. However, what was expected to establish a more or less automatic recognition of credits on a transnational level resulted in quite a lot of confusion as HEIs or individual signatory countries calculated the overall credits with different workloads, ranging from 20 to 30 or even more hours, per credit. In addition, in most cases it was and is still not clear what level of quality and achievement is connected with certain credits.

At times, this has resulted in problems with the recognition of credits even at national level. To reduce these problems, some HEIs constituted networks where the members guarantee automatic recognition of credits for exchange students of the HEIs being members of the respective network, but not for those from external HEIs.

Problems with regard to recognition of credits also arise from the assessment and grading regulations in the ECTS system. Programme developers and teachers are advised to make use of the official ECTS Guide which has been up-dated several times based on the experiences
and data collected. However, the problems mentioned above still persist with different approaches being used to arrive at satisfactory solutions.

**South Africa and Namibia** also underwent important changes of their Higher Education System during the past 15 years, in particular a significant expansion and the up-grading of former Technikons into Universities of Technology in South Africa and the Polytechnic of Namibia into the Namibia University of Science and Technology (NUST), resulting in revision of curricula, new programmes and qualifications and increasing internationalisation. Current changes are based on revised and internationally comparable National Qualifications Frameworks.

South Africa has a vibrant and expanding higher education sector, with 23 state-funded tertiary institutions: 11 Universities, 6 Universities of Technology and 6 Comprehensive institutions. The overall responsibility for higher education lies with the Ministry of Higher Education and Training. South African partners of the PEESA project are 3 of the 6 Universities of Technology:

- Cape Peninsula University of Technology (CPUT),
- Tshwane University of Technology (TUT) and
- Vaal University of Technology (VUT).

This type of University is fairly new in South Africa and is a result of a comprehensive restructuring of the Higher Education system initiated by the Ministry in 2002. The six universities have been established in between 2004 and 2006 based on mergers and incorporations of existing schools, primarily former Technikons. Besides engineering they offer programmes in other disciplines, too. Their mission includes also research, mainly application oriented research, and the delivery of qualifications at undergraduate and postgraduate level including Master and Doctorate degrees. In 1993, the Technikons Act was promulgated, which allowed Technikons to offer Bachelor’s degrees (BTech), Master’s and Doctoral degrees in Technology. However, the majority of qualifications awarded are on the undergraduate level comprising Certificate, Diploma and Degree qualifications. In

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engineering the dominating degree qualification at Universities of Technology is the Bachelor of Technology (BTech), which in some but not all engineering branches can be extended to a Master of Technology (MTech) at the post-graduate level. A BTech is awarded after a one year programme on top of a three year National Diploma (ND) programme. It differs from the Bachelor of Engineering (BEng) or the Bachelor of Science in Engineering (BScEng) qualifications which are awarded by the traditional universities and are based on 4 years of study in the full time mode. They can be extended towards a Master of Engineering (MEng) or Master of Science (MSc) by 1 to 2 years of study.

Based on the revised South African National Qualifications Framework from 2013 also the Universities of Technology will be obliged to offer MEng and new Professional Master Programmes in the limits of a DHET approved Programme and Qualification Mix (PQM) for each university. Similar developments take place in Namibia and will result in an increase of programmes on post-graduate level at the Namibian University of Science and Technology. Currently respective study programme revisions and curriculum developments are under way, attempting in due course to apply new teaching and learning approaches and quality assurance measures. All programmes have to undergo a state accreditation and the qualifications have to be registered in order to be recognized. Voluntarily, programmes in certain disciplines can also apply for an additional professional accreditation by respective state recognized bodies.

In engineering and technology professional accreditation in South Africa and also Namibia is handled by the ECSA, the Engineering Council of South Africa, which is a member of the Washington Accord and the International Engineering Alliances (IEA).

1.2 Qualification Frameworks as Reference for Quality Assurance and Programme Design and Revision

South Africa and Namibia as well as the 47 European signatory countries have implemented National Qualification Frameworks which function as reference for quality with regard to various educational levels and allow the assignment of existing or new qualifications to a certain level of the respective Framework.

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In 2013 a revision of the National Qualifications Framework (NQF) of South Africa resulted in new qualifications or new names for existing qualifications. The new qualifications are introduced to align with the National Qualifications Framework, in particular the new Higher Education Qualification Sub-Framework (HEQSF).\(^5\) This is a requirement placed on all Higher Education Institutions (HEI) in the attempt to keep the curriculum relevant. The new qualifications ensure that the curriculum offered at a certain university can be directly compared to that of other institutions, not only nationally, but also internationally through the benchmarking process that took place during the development of these new qualifications. The current qualification “National diploma” will be replaced by “Diploma”, the “BTech” by “Advanced Diploma”, the “MTech” by “Master” and the “DTech” by “Doctorate” , each qualification type accordingly specified by programme related designators (e.g. Engineering) and qualifiers (e.g. Electrical).\(^6\) From 2016 onwards the shift to the new qualifications will take place. For the Universities of Technology this reform will result in the introduction of MEng qualifications. It facilitates the implementation of the engineering master programmes in energy efficiency as developed in the PEESA project.

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\(^5\) Higher Education Qualification Sub-Framework (HEQSF) as Gazetted by the South African Department of Education on 2 August 2013

The new NQF has 10 exit levels, one more than the previous one.

Figure 1: National Qualifications Framework-SAQA

The NQF is a single integrated system comprising three coordinated qualifications Sub-Frameworks. These are:

- General and Further Education and Training Sub-Framework (GFETQSF)
- The Higher Education Qualifications Sub-Framework (HEQSF)
- The Occupational Qualifications Sub-Framework (OQSF)

The Higher Education Qualifications Sub-Framework (HEQSF) ranges from Level 5 to Level 10. These 6 levels cover 11 different qualification types. Some levels have more than one qualification type. Some qualification types have specific variants. The framework comprises the following qualification types:

- Undergraduate:
  - Higher Certificate
  - Advanced Certificate
  - Diploma
  - Advanced Diploma
  - Bachelor's Degree

- Postgraduate:
  - Postgraduate Diploma
  - Bachelor Honours Degree
  - Master's Degree
  - Professional Master's Degree
  - Doctoral Degree
  - Professional Doctorate

10 categories are used in the level descriptors to describe applied competencies across each of the 10 levels of the National Qualifications Framework:

- Scope of knowledge
- Knowledge literacy
- Method and procedure
• Problem solving
• Ethics and professional practice
• Accessing, processing and managing information
• Producing and communicating of information
• Context and systems
• Management of learning
• Accountability

It should be noted that the SA NQF compared to the European Frameworks addresses more dimensions explicitly.

Master degrees are on Level 9, Doctorate degrees on Level 10. Along with the general Master’s degree, a Professional Master’s degree was introduced. In addition, the general master’s degree can also be a research master either by dissertation or by coursework and mini-dissertation.8

Europe saw similar approaches and developments of Qualifications Frameworks. On the transnational level they differ with regard to the number of levels and usually do not specify qualification types. They show comparable features with the shift to outcomes based definition of level indicators and to a student workload based credit system. At the 2005 Bergen Bologna Follow-up-Conference agreements were reached which resulted in the “Qualifications Framework of the European Higher Education Area (QF-EHEA)” and the “European Standards and Guidelines for Quality Assurance in Higher Education (ESG)”. Signatory countries of the Bologna Process that had not already done so, were requested to develop and implement national and institutional quality assurance systems and in particular a National Qualifications Framework in accordance with the adopted and overarching European one.

Crucial was the shift from in-put based structures (e.g. years of education and training, content) to outcomes based frameworks and notional student learning time documented by credits. In a study on the applications of learning outcomes associated with the Bologna Process it was stated:

8 Higher Education Qualifications Sub-Framework (HEQSF), Government Gazette 38 116 of October 14th 2014
“Learning outcomes are acknowledged as one of the basic building blocks of European higher education reform. Learning outcomes are statements of what a learner is expected to know, understand and/or be able to demonstrate at the end of a period of learning. They are explicit assertions about the outcomes of learning - the results of learning. Learning outcomes are concerned with the achievements of the learner rather than the intentions of the teacher (expressed in the aims of a module or course). They can take many forms and can be broad or narrow in nature. They are usually defined in terms of a mixture of knowledge, skills, abilities, attitudes and understanding that an individual will attain as a result of his or her successful engagement in a particular set of higher education experiences. In reality, they represent much more than this. They exemplify a particular methodological approach for the expression and description of the curriculum (modules, units and qualifications) and level, cycle and qualifications descriptors associated with the ‘new style’ Bologna qualifications frameworks.”

The overarching Framework of Qualifications for the EHEA of 2005, based on the previously developed “Dublin Descriptors”, defines learning outcomes for the three degree levels of the Bologna structure and a possible sub-degree level within the first cycle with regard to five dimensions:¹⁰

- knowledge and understanding
- applying knowledge and understanding
- making judgements
- communication skills
- learning skills

The resultant defined outcomes are generic and do not address specific disciplines, qualification profiles or types of higher education institutions. They therefore need to be complemented by domain or subject specific frameworks dealing with different disciplines or professions and serving different purposes. As will be outlined later, this has taken place with the support of the European Commission in quite a number of disciplines like Engineering (EUR-ACE), Informatics and Computing (EQUANIE), Chemistry, Economics and

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⁹ Adam, Stephen, 2008, Learning outcomes, current developments in Europe
¹⁰ Bologna Working Group on Qualifications Frameworks, 2005
Management (EQUIS), Music, mainly for the purpose of transnational professional recognition and embedded in accreditation or labeling procedures.

One advantage of the Framework of Qualifications of the EHEA is that it covers not only cognitive dimensions of qualifications but also learning outcomes with regard to social and personal skills. Respective learning outcomes for the five dimensions are defined for the 3 degree levels plus a possible sub-degree level. As a consequence, European discipline or subject specific frameworks and related accreditation standards like EUR-ACE specify learning outcomes for the first (bachelor) as well as for the second cycle (master) degrees.

In addition to the Bologna Process network with currently 47 signatory countries the European Union (EU) with 28 member states formally adopted in 2008 a more comprehensive “European Qualifications Framework for Lifelong Learning (EQF-LLL)” with 8 levels covering not only higher education but also all secondary and vocational education qualifications which follow the compulsory education at primary and secondary level. The EQF-LLL uses 3 dimensions: knowledge, skills and competences, to specify the expected outcomes at each of the 8 levels. Even if the phrasing is slightly different, it is argued that the 4 levels of the Bologna Framework are substantially equivalent to the levels 5 to 8 of the EQF: Level 6 corresponds to the first cycle degree level of the Bologna Framework, usually termed bachelor level, Level 7 to the second cycle degree or master level and Level 8 to the doctorate level.

The EQF-LLL applies to all types of education, training and qualifications, from school education to academic, professional and vocational education. Like the Bologna Framework for higher education qualifications this approach shifts the focus from the traditional institutional or programme accreditation which is based on 'learning inputs', such as the length of a study programme, the range and content of subjects and courses, number of contact hours and the type of institution towards learning outcomes and its achievement. It also encourages lifelong learning by promoting the validation of non-formal and informal learning.

The EU member states have been advised to develop National Qualifications Frameworks (NQF) and reference them against the EQF-LLL or to the QF-EHEA of the Bologna Process. Countries which already had NQFs with more than 8 levels, like for instance the UK, were not required to adapt these frameworks to the 8 levels of the EQF as long as an appropriate

11 European Communities, 2008, European Qualifications Framework for Lifelong Learning (EQF-LLL)
and convincing mapping between different levels can be demonstrated. In some countries a
controversial debate arose between different stakeholders because of the differences in focus
and wording of the QF-EHEA compared to the EQF-LLL. In Germany the universities prefer
to stick to the Bologna agreements and the corresponding 3 levels of the German
Qualifications Framework for Higher Education of 2005, whereas the Federal Government
and the Federal States as well as the vocational education sector prefer the comprehensive 8
level EQF with learning outcomes addressing not only knowledge and skills but also
competences. The EQF-LLL was meanwhile used to create an 8 level German Qualifications
Framework which facilitates the comparison and recognition of qualifications from the
vocational and training sector with the ones from higher education.

The German case illustrates the fact that, at national and HEI level, a range of different but
increasingly outcomes based directives and references can be in place. France for example
ABET 2010-2011 Accreditation Policy and Procedure Manual applies a special set of
standards, administered by the Commission de Titre, to accredit Grandes Ecoles and their
programmes leading to the degree and title of “Ingenieur diplome”, which in the Bologna
structure is recognised as a second cycle degree. Germany for the purpose of programme
accreditation and curriculum development decided that at the second cycle level there should
be a distinction between more practice oriented and more theory and research oriented
profiles reflected in different learning outcomes and even names of degrees, like “master of
engineering” or “master of science”. And – as previously mentioned - the HEIs in the UK, in
addition to offering 3 years bachelor and bachelor honours programmes, followed by 1 to 2
years master programmes, continue to provide 4 years integrated programmes directly leading
to a “Master of Engineering” (MEng) degree. This UK differentiation arose as a result of a
master degree becoming the required qualification for entry into the phase of Initial
Professional Development (IPD), which can lead to the award of the professional title and
registration as “Chartered Engineer”.

Transnational and national Qualifications Frameworks, besides determining level indicators
and learning outcomes, usually also specify the minimum notional duration of studies with
regard to different levels and achievements of qualifications on a certain level, increasingly no
longer in terms of years or semesters but in terms of credits, based on student workload. In
South Africa and Namibia like in the UK a year of study consists of 120 credits, each credit
counting for 10 hours of student workload. In Europe, a year of study usually consists of 60
ECTS (European Credit Transfer System) credits. One credit counts for a workload of 25 – 30
hours. It was claimed that 2 UK credits correspond to 1 ECTS credit. This caused problems of comparability, as two credits of the UK as well as the SA and NA system amount to 20 hours student workload compared to 25 or 30 of an ECTS credit. However, both systems require that a defined number of credits are assigned to each course or module of a certain level so that students know how to accumulate the number of credits necessary to achieve a certain qualification.

State directives and regulations, qualifications frameworks or accreditation guidelines usually function as references for curriculum development as well as for comparability and recognition issues, describing threshold standards in terms of required learning outcomes and credits, sometimes subjects or even content. Many higher education institutions, in particular research intensive universities, based on their autonomy have the interest and right to set standards above these threshold standards, for various reasons. They increasingly apply an outcomes based approach in order to develop and implement their programmes and to assure their quality. Also recognition and promotion of programmes on a global education market becomes much easier and transparent for stakeholders and potential customers. Nationally and internationally, quite a number university networks exist with a special mission and a specific range of learning outcomes they are committed to.

Thus, referring to national or international directives, qualifications frameworks or accreditation standards is one issue. Going beyond threshold requirements and striving for more ambitious aims is another one. Both strategies profit from programme design approaches based on learning outcomes, if handled properly.

1.3 Qualification Standards for Engineering Education

Qualification Frameworks are generic and need to be specified with regard to disciplines/branches or professions. Only few countries in Europe still rely on detailed, often in-put driven recommendations or requirements for the various disciplines or even individual programmes (e.g. Russia). Usually it is up to universities and discipline related University Networks or Professional Associations or external Quality Evaluation Units like accreditation agencies to define graduate attributes or learning outcomes for specific disciplines or branches of disciplines, related to the level indicators of Qualifications Frameworks. Meanwhile various examples for discipline and subject related frameworks exist, also in engineering.
Some of them are transnational, like the graduate attributes list of the International Engineering Alliance (IEA) and the Washington Accord (WA) as one of its member alliances dealing with engineering programme accreditation. The WA focuses on the first degree as entry qualification into the profession of engineering. In Europe the ENAEE EUR-ACE framework standards and guidelines (EAFSG), which function as reference for professional accreditation in the meanwhile 17 European member countries of ENAEE, are increasingly used as a threshold benchmark. The EAFSG specify engineering programme outcomes for the first (bachelor) as well as the second degree level (master) in generic terms, not for single branches of engineering. A few branch related frameworks also exist in Europe, like in process engineering or civil engineering. In addition, some transnational university networks drafted their own frameworks for the purpose of enhancing and ensuring quality and for mutual recognition of degrees and programmes, in particular the CDIO Network and the so called TUNING project.

Likewise, the Engineering Council of South Africa (ECSA) as recognized Professional Body accrediting engineering degree programmes in South Africa and Namibia, has defined programme requirements and graduate attributes for bachelor degrees in engineering in accordance with the Washington Accord, but recently also programme requirements and outcomes for professional master programmes in accordance with the new NQF of South Africa.\(^{12}\)

For professional accreditation it is necessary to provide evidence that programmes satisfy the respective requirements and achieve the programme learning outcomes. Even if professional accreditation in addition to state accreditation is not envisaged, it is recommended to refer to these engineering specific frameworks when designing and implementing new engineering programmes because they function as a benchmark for transnational quality assurance and facilitate international recognition of qualifications.

1.4 Comparability of Master Level Descriptors and Qualification Standards between Southern Africa and Europe

For transnational curriculum development, student exchange and international recognition of qualifications or professional labels it is essential that the range of learning outcomes and competences including levels of achievements are comparable and substantially equivalent with regard to a certain level or qualification.

The new SA NQF specifies the 10 dimensions of the descriptors for Level 9, the master level, as follows:13

a. **Scope of knowledge**, in respect of which a learner is able to demonstrate specialist knowledge to enable engagement with and critique of current research or practices, as well as advanced scholarship or research in a particular field, discipline or practice.

b. **Knowledge literacy**, in respect of which a learner is able to demonstrate the ability to evaluate current processes of knowledge production, and to choose an appropriate process of enquiry for the area of study or practice.

c. **Method and procedure**, in respect of which a learner is able to demonstrate a command of and the ability to design, select and apply appropriate and creative methods, techniques, processes or technologies to complex practical and theoretical problems.

d. **Problem solving**, in respect of which a learner is able to demonstrate: the ability to use a wide range of specialised skills in identifying, conceptualising, designing and implementing methods of enquiry to address complex and challenging problems within a field, discipline or practice; and an understanding of the consequences of any solutions or insights generated within a specialised context.

e. **Ethics and professional practice**, in respect of which a learner is able to demonstrate the ability to make autonomous ethical decisions which affect knowledge production, or complex organisational or professional issues, and the ability to critically contribute to the development of ethical standards in a specific context.

f. **Accessing, processing and managing information**, in respect of which a learner is able to demonstrate the ability to design and implement a strategy for the processing and

13 SAQA, 2012, Level Descriptors for the National Qualifications Framework
management of information, in order to conduct a comprehensive review of leading and current research in an area of specialisation to produce significant insights.

g. Producing and communicating information, in respect of which a learner is able to demonstrate the ability to use the resources of academic and professional or occupational discourses to communicate and defend substantial ideas that are the products of research or development in an area of specialisation; and use a range of advanced and specialised skills and discourses appropriate to a field, discipline or practice, to communicate with a range of audiences with different levels of knowledge or expertise.

h. Context and systems, in respect of which a learner is able to demonstrate the ability to make interventions at an appropriate level within a system, based on an understanding of hierarchical relations within the system, and the ability to address the intended and unintended consequences of interventions.

i. Management of learning, in respect of which a learner is able to demonstrate the ability to develop his or her own learning strategies, which sustain independent learning and academic or professional development; and can interact effectively within the learning or professional group as a means of enhancing learning.

j. Accountability, in respect of which a learner is able to demonstrate the ability to operate independently and take full responsibility for his or her own work, and, where appropriate, to account for leading and initiating processes and implementing systems, ensuring good resource management and governance practices.”

For the state accreditation of new programmes universities and respectively programme providers have to demonstrate that the intended exit level outcomes comply with the quoted descriptors.

The two overarching European Qualifications Frameworks have fewer dimensions and are less detailed with regard to descriptors and outcomes. Considering the master or second cycle level outcomes it should be kept in mind that they usually extend the outcomes already achieved during the first cycle of studies. This is reflected in the Bologna QF-EHEA specifications of outcomes for the second cycle level, the master level:

“Qualifications that signify the completion of the second cycle are awarded to students who:
- have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with Bachelor’s level, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context;

- can apply their knowledge and understanding and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study;

- have the ability to integrate knowledge and handle complexity and to formulate judgements with incomplete or limited information and includes reflecting on social and ethical responsibilities linked to the application of their knowledge and judgements;

- can communicate their conclusions, and the knowledge and rationale underpinning them, to specialist and non-specialist audiences clearly and unambiguously;

- have the learning skills to allow them to continue to study in a manner that maybe largely self-directed or autonomous.\textsuperscript{14}

The European Qualifications Framework (EQF-LLL) specifies the master level in the three dimensions as follows:

**Knowledge:**

- highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research;

- critical awareness of knowledge issues in a field and at the interface between different fields;

**Skills:**

- specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields;

**Competences:**

\textsuperscript{14} Bologna Working Group on Qualifications Frameworks,2005, A Framework for Qualifications for the European Higher Education Area
- manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches;
- take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams.”\(^{15}\)

It should be noted that the EQF-LLL already at the bachelor level expects “advanced skills, demonstrating mastery and innovation required to solve complex and unpredictable problems in a specialised field of work or study.” Concerning competences it requires graduates at this level to be able to “manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work or study contexts and take responsibility for managing professional development of individuals and groups”\(^{16}\).

Despite some differences in detail and in wording, comparing the Southern African and European Qualifications Frameworks for the master level it can be considered that they are substantially equivalent with regard to the generic descriptions of expected knowledge, skills and competences of master level qualifications. This in general also applies to the qualifications permitting access to the master level.

Whether the level of achievement is comparable can only be judged when discipline and subject specific and finally programme related outcomes are compared. An issue of concern maybe the number of credits and the notional student workload assigned to the level. The credit systems of South Africa and Europe are slightly different. Whereas in the European Credit accumulation and Transfer System (ECTS) a year of full time study counts for 60 ECTS credits with 25 to 30 hours workload assigned to each credit (1500 -1800 hours per year) the South African system at the undergraduate level comprises 120 credits with 10 hours’ workload per credit (1200 hours resulting from 30 weeks of study per year, each of it with an average workload of 40 hours). However, on the post-graduate level and thus applicable to all master programmes the new HEQSF system counts for 180 credits per year, based on the assumption that a full time student would study 45 weeks, each one with a calculated workload of 40 hours, all together 1 800 hours. Formally and if it would be proved this would be comparable to the European Framework which requires 60 to 90 ECTS for a master programme, minimum 60 on the advanced level.

\(^{16}\) European Parliament Council, April 2008, Recommendation on the establishment of the European Qualifications Framework on lifelong learning
However, for professional accreditation of a new master degree programme, international recognition and award of international labels like EUR-ACE it is more crucial that the learning outcomes are comparable and that convincing evidence is provided that the required outcomes are achieved by the students at the time of graduation. A professional accreditation with the award of a EUR-ACE Master label will be facilitated if new programmes in engineering do not only satisfy the standards of the generic Qualification Frameworks but also requirements of engineering related ones underlying the professional accreditation, like the ENAEE EAFSG or the ECSA ones.

ENAEE has revised its Framework Standards in 2015, taking accreditation experiences and international negotiations with the IEA into account, in addition the European Qualifications Frameworks and the revised European Standards and Guidelines for Quality Assurance in Higher Education (ESG). ECSA in engineering education has so far primarily accredited bachelor degrees as educational requirement for becoming a professional engineer. With regard to the new HEQSF, ECSA quite recently drafted a list of standards for the new qualification Professional Master of Engineering.\textsuperscript{17} In combination with a BTech the professional MEng will open the way to register as a Professional Engineer candidate with ECSA. The standards will certainly function as a benchmark for programme design at South African universities with regard to professional Master of Engineering degrees. Besides formal and shares of content related requirements the ECSA standards comprise and detail a set of 10 exit level outcomes which are comparable to the EUR-ACE Master programme outcomes. In the ECSA document it is even stated that the MEng professional standard has been intentionally written to meet or exceed the programme outcomes of the EUR-ACE Master.

The EUR-ACE Framework Standards and Guidelines have been presented in more detail at various PEESA meetings. They are summarized in the following eight learning areas:

- Knowledge and understanding
- Engineering Analysis
- Engineering Design
- Investigations

\textsuperscript{17} Engineering Council of South Africa (ECSA), Qualification Standard for Master of Engineering (Professional Practice), NQF level 9, approved by the Council, 20\textsuperscript{th} of April 2014
• Engineering Practice
• Making Judgements
• Communication and Team-working
• Lifelong Learning

In addition, with regard to the ENAEE Framework Standards and Guidelines the programmes have to satisfy requirements concerning the programme management:

“Accreditation agencies should confirm that engineering degree programmes, for which a HEI seeks accreditation, are managed to,

- achieve the programme aims,
- provide a teaching and learning process that enables students to demonstrate achievement of the programme outcomes,
- provide adequate resources,
- monitor the rules for student admission, transfer, progression and graduation,
- comply with internal quality assurance procedures.”\(^{18}\)

In comparison, the ECSA Standards for a Professional Master’s Degree specify 10 exit level outcomes and explain what has to be demonstrated by the student to prove the achievement. A “Range Statement” for each of the 10 outcomes provides further details and gives hints for the organisation of an appropriate teaching/learning environment and assessment. The 10 exit level outcomes concern:

- Problem solving
- Application of scientific and engineering knowledge
- Engineering Design
- Research, investigations, experiments and data analysis
- Engineering methods, skills and tools including information technology
- Professional and technical communication
- Sustainability and the impact of engineering activity
- Individual, team and multidisciplinary working
- Independent learning ability

\(^{18}\) ENAEE, European Accreditation Framework Standards and Guidelines, 2015
Engineering professionalism.

The exit level outcomes for this master level qualification are not only defined with reference to the South African HEQSF but also aligned with the International Engineering Alliance Graduate Attribute and Professional Competencies.

As the master thesis counts for half or at least one third of the master programme credits, ECSA has in addition specified the abilities which should be achieved by the dissertation:

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 analytics, 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;
f) the ability to report and communicate findings.

This specification goes beyond ENAEE EUR-ACE requirements and reflects the fact that the research project and final thesis work in South African and Namibian structured master programmes usually will cover 50 percent of the workload (90 out of 180 credits) and is therefore the dominating opportunity for competence achievement as required by the programme outcomes. In an ENAEE EUR-ACE context the final thesis would be treated as one module or learning experience, contributing like the other modules and courses of a programme to the attainment of the programme outcomes, but would normally not cover more than 30 ECTS credits or one third or one quarter of the total number of credits for a master programme. However, referring to the ECSA outcomes in programme and module design and implementation and providing appropriate evidence that they have been achieved on a satisfactory level upon graduation would be substantially equivalent to the requirements of ENAEE authorised European Accreditation agencies. Most probably it will match the EUR-ACE Master Label programme outcomes.
1.5 Quality Assurance in Higher Education and the Role of Programme Accreditation

In the context of the Bologna Process, the development and implementation of Qualifications Framework was accompanied by negotiations to agree on European Standards and Guidelines for internal and external quality assurance in higher education (ESG). Like the QF-EHEA also the first ESG were adopted at the Bergen - Bologna Follow-up Conference in 2005 by the ministers responsible for higher education, following a proposal prepared by the European Association for Quality Assurance in Higher Education (ENQA) in cooperation with the European Students’ Union (ESU), the European Association of Institutions in Higher Education (EURASHE) and the European University Association (EUA). Since 2005, considerable progress has been made in quality assurance as well as in other Bologna action lines such as qualifications frameworks, recognition and promotion of the use of learning outcomes, all these contributing to a paradigm shift towards student-centered learning and teaching. In 2015 a revised version of the ESG has been adopted. The basic ideas and the structure have been kept but standards and specifying guidelines for each standard are now more clearly separated and a few standards more emphasized or even added.

As stated in the new ESG, “the key goal of the Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG) is to contribute to the common understanding of quality assurance for learning and teaching across borders and among all stakeholders. They have played and will continue to play an important role in the development of national and institutional quality assurance systems across the European Higher Education Area (EHEA) and cross-border cooperation. Engagement with quality assurance processes, particularly the external ones, allows European higher education systems to demonstrate quality and increase transparency, thus helping to build mutual trust and better recognition of their qualifications, programmes and other provision. The ESG are used by institutions and quality assurance agencies as a reference document for internal and external quality assurance systems in higher education. Moreover, they are used by the European Quality Assurance Register (EQAR), which is responsible for the register of quality assurance agencies that comply with the ESG.” 19 ENAEE in its recent revision of the EUR-ACE framework standards and guidelines referred to the new ESG and advised its member agencies to become officially registered members on the EQAR list. The membership

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19 ESG 2015, Setting the context
documents that the respective agency has been successfully evaluated by an EQAR panel and is relying its activities on the ESG. The ESG addresses three areas of quality assurance:

1. HEI internal quality assurance
2. External quality assurance
3. Quality Assurance of Agencies executing external QA procedures

If an EQAR listed agency, like the German Accreditation Agency ASIIN, would be asked for professional accreditation of programmes abroad it can be taken for granted that their procedures do not only follow national regulations but rely on the ESG. In addition, the European Higher Education Institutions increasingly implement internal Quality Management (QM) structures and processes and take the ESG into account. Accordingly, the existence of a functioning internal QM system is a strong requirement in independent external accreditation procedures in order to guarantee accountability and enhancement of teaching and learning and comparability and high level of quality in the European higher Education Area.

The ESG are based on the following four principles for quality assurance in the EHEA:

- Higher education institutions have primary responsibility for the quality of their provision and its assurance;

- Quality assurance responds to the diversity of higher education systems, institutions, programmes and students;

- Quality assurance supports the development of a quality culture;

- Quality assurance takes into account the needs and expectations of students, all other stakeholders and society.

The ESG recommendations for the HEIs internal quality assurance consist of the following 10 standards:

“1. Policy for quality assurance: Institutions should have a policy for quality assurance that is made public and forms part of their strategic management. Internal stakeholders should develop and implement this policy through appropriate structures and processes, while involving external stakeholders.

2. Design and approval of programmes: Institutions should have processes for the design and approval of their programmes. The programmes should be designed so that they meet the
objectives set for them, including the intended learning outcomes. The qualification resulting from a programme should be clearly specified and communicated, and refer to the correct level of the national qualifications framework for higher education and, consequently, to the Framework for Qualifications of the European Higher Education Area.

3. Student-centred learning, teaching and assessment: Institutions should ensure that the programmes are delivered in a way that encourages students to take an active role in creating the learning process, and that the assessment of students reflects this approach.

4. Student admission, progression, recognition and certification: Institutions should consistently apply pre-defined and published regulations covering all phases of the student “life cycle”, e.g. student admission, progression, recognition and certification.

5. Teaching staff: Institutions should assure themselves of the competence of their teachers. They should apply fair and transparent processes for the recruitment and development of the staff.

6. Learning resources and student support: Institutions should have appropriate funding for learning and teaching activities and ensure that adequate and readily accessible learning resources and student support are provided.

7. Information management: Institutions should ensure that they collect, analyse and use relevant information for the effective management of their programmes and other activities.

8. Public information: Institutions should publish information about their activities, including programmes, which is clear, accurate, objective, up-to-date and readily accessible.

9. On-going monitoring and periodic review of programmes: Institutions should monitor and periodically review their programmes to ensure that they achieve the objectives set for them and respond to the needs of students and society. These reviews should lead to continuous improvement of the programme. Any action planned or taken as a result should be communicated to all those concerned.

10. Cyclical external quality assurance: Institutions should undergo external quality assurance in line with the ESG on a cyclical basis.”

The guidelines for each standard specify possible consequences and ways for implementation. In the revised ESG of 2015 a stronger emphasis was put on student-centred learning and appropriate assessment, on teaching staff development and on on-going monitoring and
review of programmes. For the design and approval of programmes (Guidelines 1.2) it is stated:

“Study programmes are at the core of the higher education institutions’ teaching mission. They provide students with both academic knowledge and skills including those that are transferable, which may influence their personal development and may be applied in their future careers.

Programmes

- are designed with overall programme objectives that are in line with the institutional strategy and have explicit intended learning outcomes;
- are designed by involving students and other stakeholders in the work;
- benefit from external expertise and reference points;
- reflect the four purposes of higher education of the Council of Europe such as
  - preparation of the labor market
  - preparation for life as active citizens in democratic societies
  - personal development
  - the development and maintenance of a broad, advanced knowledge base
- are designed so that they enable smooth student progression;
- define the expected student workload, e.g. in ECTS;
- include well-structured placement opportunities where appropriate;
- are subject to a formal institutional approval process.”

For **South Africa and respectively Namibia** it can be considered that there maybe not such an emphasis and explicit regulation of internal and external quality assurance. However, the current procedures of programme approval by the DHET, registration by SAQA and state accreditation, followed by continuous monitoring and cyclical reviews of programmes address more or less the same issues. This is reflected in the various paragraphs and questions Framework for Qualifications of the EHEA in the online HEQC application for programme
accreditation. In addition, regarding internal quality assurance HEIs and also the PEESA partner universities started to implement regular quality evaluation and enhancement activities and established curriculum design and staff development support units as well as quality management structures. The Namibian University of Science and Technology (NUST), former PoN, in particular presented and started to install an elaborated Quality Management System, developed with the support of international experts and partly based on the use of up-to-date electronic data collection and monitoring facilities. The QM system addresses five quality assurance areas:

1. Management of Programme Accreditation and Institutional Audit
2. Policy Development and Management
3. Quality Reviews
4. Management of Learning through Surveys
5. Management of Academic Integrity.\(^{20}\)

The following graph shows the NUST Quality Management Framework:

\(^{20}\) NUST Quality Assurance Department, Quality Management Framework, draft, May 2014
If this comprehensive system would be completely implemented and supports continuous quality enhancement of teaching and learning it would also satisfy the intentions of the European Standards and Guidelines (ESG) and facilitate professional accreditation by an ENAEE authorised agency.

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21 PoN, Quality Management Framework, p. 19, 2014
2 Systematic Approaches of Programme Design and Curriculum Development

Programme design and continuous development of curricula and of teaching and learning is explicitly emphasised in the Higher Education Law of some European countries as a central responsibility and duty of the Higher Education Institutions. In the situation of growing autonomy of universities on the one side and the corresponding call for greater accountability on the other, regular external and internal quality evaluations and the implementation of comprehensive quality management systems are substantial and required.

Curriculum development in higher education is often focused on actions limited in scope like up-dating syllabi, introducing new courses or modules or implementing new teaching/learning approaches like collaborative learning or problem based learning (PBL). Even the creation of new programmes is generally not embedded into a strategic, comprehensive and systematic process of programme design and quality enhancement. On the contrary, curriculum development or revision in practice quite often is just a bargaining process between faculty members and university management on the basis of existing experiences and the availability of resources than an educational research based systematic approach. These negotiation processes are mainly focused on reaching agreements for a particular programme about range of subjects, syllabus and content, the number of teaching hours per course or module and examination requirements.

During the nineties of the past century more systematic and comprehensive approaches to curriculum development or revision became internationally known, based on new and theoretically grounded concepts. The application of these approaches also profited from increased requirements on sustainable quality assurance and enhancement and from external accreditation of programmes. John Heywood (2005) in his publication “Engineering Education: Research and Development in Curriculum and Instruction” started with a definition of curriculum as of being “the formal mechanism through which intended educational aims are achieved. Since educational aims are achieved through learning, the curriculum process is described by those factors that bring about learning”. This definition puts a strong focus on educational aims and learning processes and not on content. The

22 Heywood, J., 2005, Engineering Education: Research and Development in Curriculum and Instruction, p. 3
sylabus is just one part of the curriculum. Providing an overview of various models of curriculum design he also demonstrated that the increasingly complex models, in addition to aims and learning objectives and to learning processes, put a strong emphasis on assessment and evaluation dealing with the achievement of the objectives.

The PEESA project partners discussed two of the theoretical concepts:

- the “constructive alignment approach” and
- the “backward design approach”.

In addition, some recent approaches developed and applied transnationally in engineering education have been taken into consideration, in particular

- the ABET two-loop process and
- TUNING.

They will be briefly introduced in this chapter. As Vaal University of Technology (VUT) already had developed a more systematic process of programme design and curriculum development based on the “backward design” approach, it was agreed to use it as a reference and derive the necessary steps for the PEESA programme design from their model, enriched by forms and experiences from the other sources. The approach will be described in Paragraph 2.5.

2.1 The “Constructive Alignment” Concept

Curriculum theory since long and in particular at school level has been dealing with the question what kind of content should be delivered with regard to certain educational aims and objectives and how the chosen content should be taught. Meanwhile the focus has shifted from teaching to learning, placing the learner at the centre of all educational activities and focusing on his or her achievement of necessary or valuable knowledge, skills, attitudes and competences. This so called “paradigm shift from teaching to learning” resulted in a perception of the curriculum as a system, which comprehensively addresses and aligns all the necessary contributors to a successful learning process. Besides input and context factors, these contributors embrace

- aims and objectives,
- related learning outcomes,
- content,
- teaching/learning arrangements and activities,
- performance and outcomes assessment and
- continuous feed-back and quality improvement.

This is reflected in a quite influential concept developed in the UK by John Biggs in 1996 under the heading of “Constructive alignment”. It was adopted by some HEIs in Australia and Asia and in 2002 for application in higher education also by the UK Learning and Teaching Support Network (LTSN), a network which meanwhile has been replaced by the UK Higher Education Academy. John Biggs explained the concept in the following way:

“The ‘constructive’ aspect refers to what the learner does, which is to construct meaning through relevant learning activities. The ‘alignment’ aspect refers to what the teacher does, which is to set up a learning environment that supports the learning activities appropriate to achieving the desired learning outcomes. The key is that the components in the teaching system, especially the teaching methods and the assessment tasks, are aligned to the learning activities assumed in the intended outcomes”23.

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23 Biggs, John B., 1996, Enhancing teaching through constructive alignment
The following graph illustrates the components of the teaching/learning system:

![Diagram](image)

**Figure 3: Constructive Alignment**

Biggs “constructive alignment” concept was primarily devoted to teaching staff in higher education in order to enhance the quality of teaching and learning based on the definition of “Intended Learning Outcomes” at course level. Under the title “Teaching of Quality Learning at University” Biggs together with C. Tang published a more detailed version which in its most recent edition of 2009 comprises many examples of good practice of how to implement sustainable “Outcome Based Teaching and Learning” (OBTL) using various ways and tools of aligning the key components of teaching and learning.

From the examples it becomes obvious that the concept with its focus on learning can be successfully applied also at programme level and even at the institutional level, provided it is driven by faculty and teaching staff and based on a scholarly culture of teaching and learning and not a primarily “managerial” approach, striving only for accountability and the satisfaction of externally required outcomes. Nevertheless, the focus on learning and achievement of programme outcomes and the alignment with appropriate teaching and learning arrangements and assessment procedures corresponds perfectly to current outcomes.

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25 Biggs, John B. and Tang, Catherine, 2009, Teaching for Quality Learning at University
based curriculum development approaches, as does OBTL based planning and execution of courses or modules.

2.2 The “Backward Design” Concept

Vaal University of Technology (VUT), as a partner of the PEESA project, based its university guidelines for the creation and revision of programmes on the concept of “backward design”. Similar to the “constructive alignment” concept, this approach was originally developed to support school teachers in their course planning and preparation of teaching and learning situations but functions also as an approach for programme design and curriculum development. The USA educationalists Grant Wiggins and Jay Mc Tighe are considered to have popularised “backward design” by their book “Understanding by Design”, published first in 1992.

“As a strategy for designing, planning, and sequencing curriculum and instruction, backward design is an attempt to ensure that students acquire the knowledge and skills they need to succeed in school, college, or the workplace. In other words, backward design helps educators create logical teaching progressions that move students toward achieving specific—and important—learning objectives. Generally speaking, strategies such as backward design are attempts to bring greater coherence to the education of students—i.e., to establish consistent learning goals for schools, teachers, and students that reflect the knowledge, skills, conceptual understanding, and work habits deemed to be most essential.”

Backward design arose in tandem with the concept of learning standards as stated in higher education for instance in the form of graduate attributes or intended learning outcomes. It is widely viewed as a practical process for using standards to guide the development of a curriculum, course, unit, or other learning experience. Like backward designs, learning standards are a way to greater promote consistency and commonality in what gets taught to students.

The backward design approach in the original version of Wiggins and Mc Tighe consists of three phases:

- identify the desired outcomes;

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– determine the acceptable criteria for evaluating students’ progress;

**Backward Design**

![Backward Design Diagram]

**Figure 4:** „Backward Design“

For each of these phases there are a number of benchmarks to guide the programme or course design process. Meanwhile also approaches with more steps have been developed. Other concepts have been integrated, e.g. the Anderson/Krathwohl Taxonomy for Teaching, Learning and Assessing. This taxonomy describes cognitive learning processes with respect to increasing levels of abstraction and complexity and can be used to specify intended learning outcomes and levels of achievements, starting from basic to advanced and using verbs of activities which demonstrate the attainment of outcomes. The taxonomy consists of six levels:

– **Remember**: the ability to recover and access knowledge from long-term memory

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**References**

28 ibid
- **Understand**: the ability to understand, interpret, classify, summarize and compare, and to construct meaning
- **Apply**: the ability to perform an unfamiliar task by applying previous knowledge to a new situation or problem; ability to organize, differentiate and attribute
- **Evaluate**: ability to judge, reason, and critique
- **Create**: ability to innovate and produce new knowledge

Apart from starting the planning process from programme educational objectives and intended learning outcomes, and not from content to be presented, it should be noted that the second step in this model is the determination of acceptable evidence, in other words, the appropriate assessment of learning results in comparison to the intended outcomes. The decision on content, teaching methods and provided learning arrangements follows as third step. This approach corresponds perfectly with some practices of quality evaluation and accreditation which focus on the provision of evidence that required or intended learning outcomes have been achieved by the students through the programme or course provided, not caring too much by which means. It is reflected in the two-loop model of ABET, the American Board of Engineering and Technology. Even if professional accreditation is predominantly interested in the provision of evidence that required exit level outcomes/graduate attributes have been achieved, and not in the programme planning, this model can be used for structuring the process of programme design and curriculum development, not just for accreditation procedures.

### 2.3 The ABET “Two-Loop” Model

This more practical approach to programme design was provided by ABET. ABET is recognised by the USA Council of Higher Education Accreditation (CHEA) as the sole agency responsible for the accreditation of engineering and technology related programmes in the USA. With regard to quality enhancement and accreditation of engineering programmes ABET changed its accreditation approach from a basically input related controlling check-list approach to an outcomes based approach. Programme providers have to present evidence that the ABET accreditation criteria are satisfied and also that the programme objectives and learning outcomes are achieved by the curricula and teaching and learning arrangements provided. This paradigm shift started in 1997 with the first pilot applications of the so called
“Criteria 2000” which are now the mandatory basis for ABET programme accreditation in engineering and three related areas:

- Applied Science,
- Computing and
- Engineering Technology.

In the original version ABET defined nine general criteria which had to be satisfied by the programmes applying for accreditation. Probably the best known and most widely discussed one of these general criteria is Criterion 3. It described 11 generic student outcomes that had to be achieved. Meanwhile this 3 a-k list has been modified and revised in wording. The 2016 ABET proposal for Criterion 3 in engineering contains seven student outcomes for undergraduate education. For master education student outcomes are not specified but should be accordingly defined extending the requirements and levels of attainment. The proposed revision besides ABET related experiences also takes the IEA/Washington Accord list of graduate attributes into account, which have been defined later then the Criteria 2000 between 2006 and 2009.30 The proposed ABET student outcomes in engineering are:

(1) An ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science, and mathematics.

(2) An ability to apply the engineering design process to produce solutions that meet specified needs with consideration for public health and safety, and global, cultural, social, environmental, economic, and other factors as appropriate to the discipline.

(3) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

(4) An ability to communicate effectively with a range of audiences.

(5) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

(6) An ability to recognize the ongoing need to acquire new knowledge, to choose appropriate learning strategies, and to apply this knowledge.

30 IEA, International Engineering Alliance, Graduate Attributes and Professional Competencies, Version 2 – 18th of June 2009
(7) An ability to recognize the ongoing need to acquire new knowledge, to choose appropriate learning strategies, and to apply this knowledge.”

These student outcomes requirements may be enriched by additional subject specific learning outcomes which can be defined for certain engineering disciplines represented in ABET by respective Professional Engineering Associations.

The shift towards an outcome based approach, in particular the need to provide evidence of their achievements, challenged the programme providers and resulted in a significant revision of curricula and changes of assessment patterns. To assist the HEIs to adapt to the new accreditation requirements and procedures, ABET recommended a step by step strategy to be followed for curriculum revision and assessment planning, based on a “two loop process” as shown in Figure 5.

![Figure 5: The ABET “Two Loop Process”](image)

The first cycle represents the contribution of the “external” world and stakeholder involvement and uses the inputs from students, alumni and employers to assist in the determination of the programme objectives. The second cycle represents the internal steps and procedures in a department or school responsible as programme provider. It includes the determination of the outcomes necessary to meet the stated objectives, how these outcomes will be achieved and assessed and the establishment of performance criteria. Both cycles

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contribute to the evaluation and revision of the objectives. It results in a repeatedly undertaken cyclical evaluation process that controls the work flow in each cycle.

While initially developed as a procedure for assessment and evaluation planning and implementation, the two loop approach also functions well as a model for programme design and continuous quality enhancement. It should be noted that a distinction is made between “programme educational objectives” and “student outcomes” satisfying the objectives. In the ABET terminology programme educational objectives are “broad statements that describe the career and professional accomplishments that the programme is preparing graduates to achieve.” Student outcomes are “narrower statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire in their matriculation through the program”. The corresponding terms in the ENAEE EUR-ACE Framework Standards and Guidelines (EAFSG) are “Programme aims” and “Programme outcomes”.

To demonstrate that the required student outcomes are achieved programme providers need to define performance criteria or indicators. These are specific measures, which identify the performance(s) required to meet the outcomes and which can be confirmed through evidence. The actual 2017 – 2018 ABET Manual states four areas where satisfactory evidence has to be provided. They reflect the various steps of the two-loop model, even if this model is currently no longer explicitly promoted by ABET:

“E.I.5.b.(3) Evidence that the program educational objectives (PEOs) stated for each program are based on the needs of the stated program constituencies.

I.E.5.b.(4) Evidence of a documented, systematically utilized, and effective process, involving constituents, for periodic review of the PEOs stated for each program.

I.E.5.b.(5) Evidence of the assessment, evaluation, and attainment of student outcomes (SOs) for each program.

I.E.5.b.(6) Evidence of actions taken to improve the program.”

The provision of evidence can be based on different formats. With regard to student outcomes it will include formats like tests and exams, benchmarks, rubrics, assignments, products, process observations, portfolios, etc. The predominant written or oral exams of courses or

32 ABET 2010-2011 Accreditation Policy and Procedure Manual
modules and the associated grading are normally not sufficient to provide evidence that the full range of outcomes has been achieved. Other documents should be added like student, graduates and employer as well as teaching staff surveys. It should also be noted that in the ABET terminology a distinction is made between “assessment” and “evaluation”. Assessment is defined as “one or more processes that identify, collect and prepare data to evaluate the achievement of programme outcomes and programme educational objectives.” Evaluation is “one or more processes for interpreting the data and evidence accumulated through assessment practices. Evaluation determines the extent to which programme outcomes or programme educational objectives are being achieved and results in decisions and actions to improve the programme”\textsuperscript{34}.

Assessment and evaluation are not only the basis for the accreditation decision but also for “closing the loop” and providing feedback to identify possible improvements and quality enhancements. Programme providers should continuously evaluate and undertake improvement activities and not wait until the date of the next re-accreditation. Instead, they should implement a process oriented quality management system and report on actions taken. This is defined in Criterion 4 on continuous improvement and states: “The programme must regularly use appropriate, documented processes for assessing and evaluating the extent to which the student outcomes are being achieved. The results of these evaluations must be systematically utilised as input for the continuous improvement of the programme. Other available information may also be used to assist in the continuous improvement of the programme”\textsuperscript{35}.

Programme providers have the freedom to decide on necessary courses and appropriate teaching and learning arrangements to ensure the achievement of the programme objectives and the required or intended learning outcomes and also on how to prove that they have been achieved. Criterion 5 of the original EC 2000, which dealt with curriculum matters, only identifies some minimum requirements for certain areas in the four year undergraduate curriculum.\textsuperscript{36}

In general and from the experiences gained, programme developers and providers are strongly advised not only to implement a certain curriculum but also to develop and execute a

\textsuperscript{34} ABET 2010-2011 Accreditation Policy and Procedure Manual
\textsuperscript{35} ABET 2013-2014 Accreditation Policy and Procedure Manual
\textsuperscript{36} Ibid.
documented assessment plan with regard to accreditation as well as quality enhancement. One concern often raised is that the teaching and learning processes should not be driven, distorted or even dominated by assessment activities. Only sufficient data should be collected to meet the needs of the various processes of outcome achievement, student grading, accreditation and quality assurance. Not every course or every learning outcome must be assessed each year for the purpose of accreditation. HEIs in the USA in the past decade have made significant efforts to develop appropriate assessment measures, in particular for complex non-cognitive learning outcomes, to design comprehensive assessment plans, to use electronically supported tools to gather data and to implement regular and structured evaluation procedures.

2.4. The TUNING Approach to Programme Development and Curriculum Design

“Tuning educational structure in Europe” (TUNING) was a project launched in 2002 by a group of European Higher Education Institutions (HEI) and funded by the European Commission. Its goal was to contribute to the main objectives of the Bologna process by the transformation of traditional degrees into bachelor and master degrees and the reconstruction of the logic of their underlying study programmes. “TUNING” aimed to implement the Bologna process at university level and initially concentrated on transparency and the development of a common language in the description of HE programmes, not least to enhance comparability and to foster their international recognition. Over time Tuning has developed into a process for (re-)designing, developing, implementing, evaluating and enhancing the quality of first, second and third cycle degree programmes, and thus has become a reference point for curriculum design, too.

The Tuning outcomes as well as its tools are presented in a range of Tuning publications, which institutions and their academics are invited to test and use in their own setting.37

The Tuning approach has been developed by and is meant for higher education institutions. Meanwhile the process has been further disseminated and spread to other non EU member countries including Russia and even to the continents of Latin America and Asia. Parallel to the Tuning project, which initially comprised only a limited number of disciplines, other subject areas like Engineering, Civil Engineering and Electrical Engineering collaborated in

37 Tuning, see website: http://www.unideusto.org/tuningeu/
EU funded “Thematic Networks” like E4 or EUCEET with similar and often enhanced aims. Subsequently “synergy groups” were established between these Networks and the Tuning project in order to test the Tuning approach also in these subject areas and contribute to its enhancement.

In the beginning Tuning concentrated on developing a terminology applicable to all kinds of disciplines and levels of programmes and courses for describing learning outcomes in terms of competences and made a distinction between generic and subject specific competences.

“Competences represent a combination of attributes (knowledge and its application, attitudes, skills and responsibilities) that describe the level or degree to which a person is capable of performing them”. 38

Within the generic competences 30 items have been determined and used to identify demands and achievements through questionnaires distributed to employers, graduates and academic faculty:

**Instrumental competences:**

- Capacity for analysis and synthesis;
- Capacity for organisation and planning;
- Basic general knowledge;
- Grounding in basic knowledge of the profession;
- Oral and written communication in one’s native language;
- Knowledge of a second language;
- Elementary computing skills;
- Information management skills (ability to retrieve and analyse information from different sources);
- Problem solving;
- Decision-making.

**Interpersonal competences:**

- Critical and self-critical abilities;
- Teamwork;
- Interpersonal skills;

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38 Tuning project report, see Tuning web-site: http://www.unideusto.org/tuningeu/
• Ability to work in an interdisciplinary team;
• Ability to communicate with experts in other fields;
• Appreciation of diversity and multiculturalism;
• Ability to work in an international context;
• Ethical commitment.

Systemic competences:

• Capacity for applying knowledge in practice;
• Research skills;
• Capacity to learn;
• Capacity to adapt to new situations;
• Capacity for generating new ideas (creativity);
• Leadership;
• Understanding of cultures and customs of other countries;
• Ability to work autonomously;
• Project design and management;
• Initiative and entrepreneurial spirit;
• Concern for quality;
• Will to succeed.

The Tuning Methodology or approach includes asking stakeholders from various disciplines by means of a questionnaire to identify and rank the 10 generic competences most relevant for their subject area and also to determine and rank additional competences which are specific only for their subject area. Despite the advantages of this approach for comparison and the involvement of stakeholders, the engineering education community collaborating in the previously mentioned Thematic Networks expressed their concern about this distinction. In cases where an academic subject or discipline and a profession are closely linked, like in engineering, many of the generic competences are essentially subject related and have to be seen as dimensions of complex engineering capabilities. They preferred an approach which
identified the necessary or desirable learning outcomes derived from professional practice as represented in EUR-ACE or ABET outcomes or in the CDIO39 approach.

In a later stage of the project and related to the discipline oriented sets of learning outcomes expressed in terms of generic and subject related competences, the Tuning partners enhanced their concept with recommendations about approaches to improve learning, teaching and assessment and about quality enhancement in the educational process emphasising a systems based internal institutional quality culture. A more recent result of the project is the development and provision of a concept for curriculum design, which is comparable to what has been developed in engineering and applied already in both the ABET and EUR-ACE accreditation approaches.

The so called “Tuning model” was developed for designing, implementing and delivering curricula offered within one institution, or jointly by two or more institutions. “The following main steps in the process for designing a study programme either a local programme or an (international) integrated programme / joint degree were identified:

1. Meeting the basic conditions:

For all study programmes:

- Has the social need for the programme on a regional/national/European level been identified? Has this been done on the basis of a consultation of stakeholders: employers, professionals and professional bodies?
- Is the programme of sufficient interest from the academic point of view? Have common reference points been identified?
- Are the necessary resources for the programme available inside or, if required, outside the (partner) institution(s) concerned?

For international degree programmes offered by more than one institution:

- Is there commitment of the institutions concerned? On what basis: an (official) agreement or a strategic alliance?

39 CDIO, Conceive, Design, Implement and Operate, it is the name of a transnational project and fast growing international network of universities, applying this elaborated concept of needs analysis and engineering curriculum development, information available under: http://www.cdio.org/
- Is there sufficient guarantee that the programme will be recognised legally in the different countries?
- Is there agreement with regard to the length of the programme to be designed in terms of ECTS-credits based on student workload?

1. Definition of a degree profile.
2. Description of the objectives of the programme as well as the learning outcomes (in terms of knowledge, understanding, skills and abilities) that have to be met.
3. Identification of the generic and subject-related competences which should be obtained in the programme.
4. Translation into the curriculum: content (topics to be covered) and structure (modules and credits).
5. Translation into educational units and activities to achieve the defined learning outcomes.
6. Deciding the approaches to teaching and learning (types of methods, techniques and formats), as well as the methods of assessment (when required, the development of teaching material).
7. Development of an evaluation system intended to enhance its quality constantly.

Currently TUNING is the coordinator of a new EU financed project called CALOHE, dealing with the assessment of student learning outcomes. 40

### 2.5 The PEESA Approach based on VUT Guidelines of Programme Design and Curriculum Development

The PEESA partner universities agreed that the design of programmes in energy efficiency should be grounded on a systematic, learning outcomes based approach taking national and international concepts and experiences into account. To permit the later application for a professional accreditation with a European ENAEE authorised Agency the programme design

should as far as necessary and possible refer to ENAEE EUR-ACE requirements in addition to the national requirements of compulsory state and mandatory ECSA accreditation. Professional accreditation does not require or prescribe a particular approach towards programme design. It is the responsibility of the university to determine and apply an approach which satisfy requirements for programme approval and accreditation and result in sustainable and high quality provision of learning opportunities corresponding to the mission and aspirations of the university. From the four African partner universities in the PEESA project, Vaal University of Technology (VUT) since 2010 had been focused on the elaboration and application of guidelines for systematic programme and curriculum development based on theoretical concepts, in particular the “backward design” concept. The PEESA project partners agreed to adopt this approach as far as possible for the development of the master programmes in energy efficiency at the four African partner universities.

The approach is based on the statement, that “curriculum design within the context of contemporary Higher Education is no longer synonymous with designing a syllabus. The latter concept focuses attention too narrowly on the “content” of what is taught, and ignores how it is engaged with by the learner or how learners will achieve the learning intended. Contemporary concepts of curriculum design take a more learner-centered approach and a more holistic view of the design process.”  

Concerning the learning and achievement of competences the approach is based on a constructivist learning theory and on a life-long ongoing development of knowledge and understanding, skills, attitudes and values. “Social constructivism argues that meaning and knowledge are created through social interactions, and new skills, knowledge and understanding derive in significant part from what people already know and believe (their prior experience and learning).”  

The following concepts are relevant for the curriculum approach at VUT:

- “curricula should be learner centered;
- research findings should inform curriculum design;
- the impact and format of assessment should form an integrated part of the curriculum;

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41 VUT, Academic planning working document, 2009, paragraph 15.1
42 Ibid
- a flexible approach to learning options is followed based on a blended approach to learning design;

- community engagement, service learning and work integrated learning (WIL) as included parts of the curriculum will add to the social construct of the curriculum over and above the social experience of tutorials, communities of learning, chat rooms, etc.;

- alignment of teaching, learning and assessment should form the basis of curriculum design;

- academic development and student support should be integrated in the curriculum."43

Based on the curriculum approach as described above it is evident that the challenge to meet the requirement as stated requires a systematic process. It is further evident that curriculum should be understood as an integrated entity including content and pedagogy or learning design. Based on the various elements constituting an effective curriculum, the development thereof demands the involvement of various competences in a team approach.

VUT has established a service unit for “Curriculum Development and Academic Staff Development” which is supporting programme providers and faculty in designing programmes in a systematic approach, taking the above concepts into account. The unit created the following graph of the various steps and contents of the systematic approach, which has been used to structure the PEESA programme development activities. The steps are addressed in some detail in the following chapter, enriched by instruction and forms which can be helpful for planning, implementation and monitoring processes as well as for providing evidence in the context of programme accreditation.

43 Ibid, paragraph 15.2
Figure: 6 Curriculum, Learning, Development Process
3 Steps of the Programme Design Process

3.1 Needs Analysis and Feasibility Study

For this first step of the programme design process various national and university related documents have to be taken into account, partly quoted on the following pages. The PEESA project application and the presentations at the PEESA workshops explained some of the economic and social development and workforce needs and reasons for the envisaged programmes in energy supply and efficiency for South Africa and Namibia. For the purpose of state approval of a new programme and for the detailed planning of curricula and courses related to regional and local demands and the mission and possibilities of a certain university a focused needs analysis has to be undertaken. Sometimes also a feasibility study is required. The needs analysis has to address the different stakeholders involved, in particular the potential employers but also students and governmental and regional authorities. The universities normally can decide on their own how they organise and document the needs analysis, applying the different approaches available. Often they provide guidelines to the programme developers what questions have to be answered and what kind of data provided, as exemplified by VUT and renewable energy PoN/NUST in Section 3.1.3 and 3.1.4.

These guidelines refer to the requirements for state accreditation of programmes as specified in the respective HEQC criteria. They are similar to requirements of professional accreditation like the ENAEE EUR-ACE ones, as described in the EAFSG.

3.1.1 Needs Analysis in the HEQC Criteria for Online Accreditation

<table>
<thead>
<tr>
<th>HEQC – Criterion 1 – Programme Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>The programme is consonant with the institution's mission; forms part of institutional planning and resource allocation; meets national requirements, the needs of students and other stakeholders; and is intellectually credible. It is designed coherently and articulates well with other relevant programmes, where possible.</td>
</tr>
</tbody>
</table>

Figure 7: HEQC-Criterion 1

Guidelines: Application for new formal programmes according to the HEQC Online Accreditation Criteria for candidacy phase
The Higher Education Act of 1997 assigns responsibility for quality assurance in higher education in South Africa to the Council on Higher Education (CHE). This responsibility is discharged through its permanent sub-committee, the Higher Education Quality Committee (HEQC).

The mandate of the HEQC includes quality promotion, institutional audit and programme accreditation. As part of the task of state programme accreditation the HEQC developed the HEQC online application form for new programme accreditation using 10 criteria published in the HEQC Guidelines “Application for new formal programmes according to the HEQC online accreditation criteria for candidacy phase”. Criterion 1 specifies what has to be demonstrated to rectify the application for a new programme.

3.1.2 Needs Analysis for the Purpose of Professional Accreditation

A needs analysis and feasibility study is usually also required if universities apply for a professional accreditation of a programme, e.g. executed by the Engineering Council of South Africa (ECSA) or by a European Agency authorized by ENAEE to award the EUR-ACE Bachelor or EUR-ACE Master label. The EUR-ACE Framework Standards and Guidelines (EAFSG) for the Accreditation of Engineering Programmes define the criteria to be assessed. The requirements comprise questions upon the identification of the needs of the interested parties such as students, industry and engineering associations. The self-report should give evidence of the results and the Accreditation team should check the modes and relationships with stakeholders and the needs identified for each of the interested parties.45

3.1.3 VUT: Guidelines for a Needs Analysis and Programme Feasibility Study46

The VUT’s procedure for the approval of new and significantly changed programmes requires that information is provided on various aspects of a needs analysis and a programme

45EUR-ACE Framework Standards and Guidelines for the Accreditation of Engineering Programmes EAFSG), Brussels, 2015
46Guidelines for the Approval, Accreditation, Registration and Amendment of subsidised academic programmes, VUT, 2010
feasibility study. These aspects are explained below. The first aspect concerning the needs analysis and needs assessment is explained in detail:

- A needs assessment that considers the relevance of the programme in terms of:
  - Supporting the vision and mission of the university
  - Inputs from current students, graduates, employers and the profession concerning the educational and training opportunities that should be offered by the programme
  - The requirements of the local, regional, national and international environments in terms of human resources development needs
  - The institution's educational priorities
  - The requirements of the field of knowledge

- Recruitment and enrolment planning, indicating the anticipated student numbers and the profile of the learners who will enrol for the programme.

- Work Integrated Learning (WIL) components in the programme indicating implications regarding staffing, throughput, funding insurance, registration, monitoring and enrolment management.

- An appraisal of the VUT's expertise and experience in the broad field of study; particular reference should be paid to the qualifications, publications and experience of academic staff who will offer the programme.

- Planning of the staffing requirements for the programme in view of the existing capacity.

- Planning of the infrastructural requirements for the programme taking into consideration the existing physical and information resources (i.e. venues, equipment, the library and IT facilities) on the campus of delivery.

- A provisional financial plan for the programme.

- Information on similar programmes that are offered by other higher education institutions in the region.
3.1.4 PoN/NUST: The Need for the Programme/Course

A second example considered in the PEESA project concerned the Namibia University of Science and Technology, formerly Polytechnic of Namibia. Their market survey or needs analysis should provide information about demands regarding a new programme. Questions to be answered:

- Is there a demonstrated and justifiable economic and/or social need for the programme/course?
- Are expressions of need by interest groups included?
- Is a programme/qualification the best way to address the demonstrated need? What are the employability prospects for the graduates of the programme?

The Requirement for Wide and Deep Consultation

Wide consultation requires the consultation of as many interested parties as possible. Wide consultation internally should include, at least, other departments who will have a role to play in the development and teaching of the course, faculty in other schools, and especially the Centre for Teaching and Learning. This internal consultation has the main purpose of eliminating overlap and duplication. It also serves to encourage co-operation between departments.

Wide consultation externally should include interest groups that are represented in the Advisory Committee, as well as other groups that may not be part of the Advisory Committee.

The requirement for deep consultation refers to the need to consult industry and other interested parties on every aspect of the curriculum, from constructing the qualification outcomes to agreeing assessment criteria.

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47 Polytechnic of Namibia, The Curriculum Framework, November 2009
The Requirement for Industry Involvement and Recognition

Industry should be involved throughout the process, but most importantly, it must give clear indications on whether employers will recognise the proposed qualification for employment in the industry or not.

If professional registration is required for practice in the field, the relevant professional body must give at least an indication that it will consider the qualification for recognition and at what level such recognition may result.

The Target Group(s) of the Programme

The target group of the programme must be clearly described to indicate whether there will be candidates for enrolment. If the programme is developed for a particular target group, this must also be spelled out, and an estimate must be provided of the expected lifespan of the programme.
### 3.2 The Curriculum Development Process

The various steps are illustrated by the following flow chart from the Vaal University “Guidelines for the Approval, Accreditation, Registration and Amendment of subsidised Academic Programmes”, VUT 2010:

![Flow Chart](image)

**Figure 8:** Flowchart for the Sub-process: Curriculum Development

<table>
<thead>
<tr>
<th>Input</th>
<th>Flow Diagram</th>
<th>Who</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>DoE approved programme</td>
<td>Curriculum Development Process (STEP 8)</td>
<td>Programme Coordinator, Curriculum development team</td>
<td>- Curriculum - Programmes - Modules - Assessment methods - Assessment tasks - Teaching methods - Learning methods - Programme content</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- CHE requirements for on-line registration</td>
</tr>
<tr>
<td></td>
<td>Formulate Exit Level Outcomes for clearance</td>
<td>Curriculum development team in consultation with all stakeholders, Assistance from DCD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Develop learning outcomes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Construct modules</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suggest teaching/learning methodologies</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suggest assessment Methods, -tools and -activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Develop learning support materials for programme</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Purpose of procedure:**
To ensure that the Curriculum Development Team follows the correct procedure in the development of DoE approved programmes.
3.2.1 Formulate Exit Level Outcomes (ELO)

Besides stakeholder and university mission related aspects this step has to take into account the generic Level Descriptors from the National Qualifications Frameworks, in this case those for the Master Degree programmes at Level 9. As outlined in Chapter 1 the new NQF of South Africa and also the one of Namibia contain different qualification types at Level 9 but state the level indicators and requirements in generic terms.

3.2.1.1 South Africa-NQF, Level 9

The following categories of the National Qualifications Framework describe the learning outcomes for qualifications at NQF Level 9, e.g. the master degree:

**Scope of knowledge**
- specialist knowledge to enable engagement with and critique of current research or practices; and an advanced scholarship or research in a particular field, discipline or practice

**Knowledge literacy**
- an ability to evaluate current processes of knowledge production and to choose an appropriate process of enquiry for the area of study or practice

**Method and procedure**
- a command of and ability to design, select and apply appropriate and creative methods, techniques, processes or technologies to complex practical and theoretical problems

**Problem solving**
- an ability to use a wide range of specialised skills in identifying, conceptualising, designing and implementing methods of enquiry to address complex and challenging problems within a field, discipline or practice; and an understanding of the consequences of any solutions or insights generated within a specialised context

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Ethics and professional practice

- an ability to make autonomous ethical decisions which affect knowledge production, or complex organisational or professional issues, an ability to critically contribute to the development of ethical standards in a specific context

Accessing, processing and managing information

- an ability to design and implement a strategy for the processing and management of information, in order to conduct a comprehensive review of leading and current research in an area of specialisation to produce significant insights

Producing and communicating of information

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

Context and systems

- an ability to make interventions at an appropriate level within a system, based on an understanding of hierarchical relations within the system, and the ability to address the intended and unintended consequences of interventions

Management of learning

- the ability to develop his or her own learning strategies, which sustain independent learning and academic or professional development; and can interact effectively within the learning or professional group as a means of enhancing learning

Accountability

- an ability to operate independently and take full responsibility for his or her own work, and, where appropriate, to account for leading and initiating processes and implementing systems, ensuring good resource management and governance practices
3.2.1.2 Namibia, NQF, Level 9

The figure below shows an extract from the table “Level Descriptors” of the Namibian NQF Level 9 visualized in the Namibian National Qualifications Framework.

| Level 9 | Comprehensive and systematic knowledge in a discipline or field with specialist knowledge in an area at the forefront of that discipline or field. Capacity for self-directed study and the ability to work independently. Planning and carrying out of a substantial piece of original research or scholarship to internationally recognised standards and involving a high order of skill in analysis and critical evaluation. Identification, analysis and proposed responses to real world or complex issues and problems drawing systematically and creatively on the principles, theories and methodologies of a particular discipline. Advanced information retrieval, processing, analytical, synthesising and independent evaluation of quantitative and qualitative data. Able to present and communicate academic or professional work effectively, catering for a wide range of specialist and non-specialist audiences and/or in diverse genres. |

Figure 9: NQF Level Descriptors Level 9

3.2.1.3 European Qualification Frameworks: QF - EHEA and EQF - LLL

The overarching Framework of Qualifications of the European Higher Education Area (QF-EHEA)\(^{50}\), based on the previously developed “Dublin Descriptors”, comprises three cycles (first cycle: Bachelor Degree, second cycle: Master Degree, third cycle: Doctorate) and generic descriptors for each cycle based on learning outcomes and competences combined in the following categories:

\(^{49}\) Regulations Setting-up the National Qualifications Framework for Namibia: Namibia Qualifications Authority Act, 1996

\(^{50}\) http://www.ehea.info/Uploads/QF/050520_Framework_qualifications.pdf
• Knowledge and understanding
• Applying knowledge and understanding
• Making judgements
• Communication skills
• Learning skills

Qualifications that signify completion of the second cycle (Master Level) are awarded to students who:

– have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with Bachelors level, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context

– can apply their knowledge and understanding and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study

– have the ability to integrate knowledge and handle complexity, and formulate judgements with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgements;

– can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously;

– have the learning skills to allow them to continue to study in a manner that maybe largely self-directed or autonomous.
European Qualifications Framework for Lifelong Learning (EQF-LLL), Level 7

Level 7 corresponds to the master level and is specified as follows:

<table>
<thead>
<tr>
<th>EQF Level</th>
<th>Knowledge</th>
<th>Skills</th>
<th>Competence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 7</td>
<td>Highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research</td>
<td>Specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields</td>
<td>Manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches; take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams</td>
</tr>
<tr>
<td></td>
<td>Critical awareness of knowledge issues in a field and at the interface between different fields</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 10: EQF-LLL Level Descriptors Level 7

3.2.2 Formulate Exit Level Outcomes for Engineering Master Qualifications

The level indicators and requirements of the national Qualification Frameworks have to be addressed when specifying Exit Level Outcomes (ELOs) for new programmes. As demonstrated, the accordingly defined outcomes are generic and do not address different disciplines, qualification profiles or types of higher education institutions. They therefore need to be complemented and specified by sectoral frameworks dealing with different disciplines or professions and serving different purposes. This has meanwhile taken place in quite a number of disciplines. The European standards for quality assurance of engineering education (EUR-ACE

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51 http://ec.europa.eu/ploteus/en/content/descriptors-page
Framework Standards and Guidelines) define the requirements for the professional accreditation of engineering undergraduate (bachelor) and post-graduate (master) programmes. Likewise, the Engineering Council of South Africa (ECSA) recently drafted requirements and graduate attributes for professional master programmes in accordance with the new NQF of South Africa which should be taken into account when formulating ELOs for engineering master programmes.

If a professional accreditation with an ENAEE authorised European Accreditation Agency is envisaged – like it was intended in the PEESA project – it is useful to check the requirements of individual agencies. Some of them, like the German agency ASIIN, provide also engineering branch and subject-specific requirements and differentiate between more research and more professionally oriented master programmes.

The new EUR-ACE Framework Standards and Guidelines (EAFSG) as result of a revision process in 2015 group the Exit Level outcomes with regard to eight areas instead of previous six, as the transferable skills are now differentiated under three headings. They also require a more general description of programme aims to which the programme outcomes and respectively the module learning outcomes have to contribute. ASIIN in addition has detailed the engineering related outcomes also in branch specific ones (e.g. electrical, mechanical, civil, process engineering) which can serve as additional reference.

The following details of the mentioned Frameworks should be used when deciding on ELOs and intended learning outcomes.

3.2.2.1 VUT Exit Level Outcomes for Master Degree Programmes

In the document “A Standards Framework for the accreditation of a Master’s in Engineering Programme” from Vaal University of Technology the exit level outcomes for the Master’s Degree in engineering programmes have been defined as follows:

The qualified student will be able to:

1. Identify, assess, formulate, interpret, analyse and solve engineering research and development problems creatively and innovatively by applying relevant fundamental
knowledge of i.e. Mathematics, Basic Science and Engineering Sciences in the chosen field of research.

2. Plan and manage engineering research projects, demonstrating fundamental knowledge, understanding and insight into the principles, methodologies and concepts that constitute socially responsible (to local and other communities) engineering research/development in the chosen field of research practice.

3. Work effectively, individually or with others, as a member of a team, group, organisation and the community or in multi-disciplinary environments in the chosen field of research.

4. Organise and manage him/herself and his/her activities responsibly, effectively, professionally and ethically, accept responsibility within his/her limits of competence, and exercise judgment based on knowledge and expertise pertaining to the field of research.

5. Plan and conduct applicable levels of investigation, research and/or experiments by applying appropriate theories and methodologies, and perform data analysis and interpretation.

6. Communicate effectively, both orally and in writing, with engineering and specifically research audiences and the community at large, in so far as they are affected by the research, using appropriate structure, style and graphical support.

7. Use and assess appropriate research methods, skills, tools and information technology effectively and critically in engineering research/development practice, and show an understanding and a willingness to accept responsibility for the impact of engineering research/development activities on society and the environment.

8. Perform procedural and non-procedural design and synthesis of components, systems, works, products or processes as a set of related systems, and assess their social, legal, health, safety and environmental impact and benefits, where applicable, in the chosen field of research.

9. Employ various learning strategies and skills to master outcomes required for preparing him/herself to engage in continuous learning, to keep abreast of knowledge and skills required in the engineering field.
10. Participate as a responsible citizen in the life of local, national and global communities by acting professionally and ethically in the chosen field of research.

11. Demonstrate, where applicable, cultural and aesthetic sensitivity across a range of social contexts in the execution of engineering research and development activities.

12. Explore, where applicable, education and career opportunities through engineering problem-solving, design, technical research and managerial skills.

13. Organise and develop entrepreneurial opportunities through engineering, technical research, development and/or managerial skills.

3.2.2.2 EUR-ACE Framework Standards and Guidelines (EAFSG) for Programme Outcomes of Master Degree Programmes

- **Knowledge and Understanding**

The learning process should enable Master Degree graduates to demonstrate:

- in-depth knowledge and understanding of mathematics and sciences underlying their engineering specialisation, at a level necessary to achieve the other programme outcomes;
- in-depth knowledge and understanding of engineering disciplines underlying their specialisation, at a level necessary to achieve the other programme outcomes;
- critical awareness of the forefront of their specialisation;
- critical awareness of the wider multidisciplinary context of engineering and of knowledge issues at the interface between different fields.

- **Engineering Analysis**

The learning process should enable Master Degree graduates to demonstrate:

- ability to analyse new engineering products, processes and systems within broader or multidisciplinary contexts related to their field of study, and to select and apply the most appropriate and relevant methods from established analytical, computational and experimental methods or new and innovative methods;
- ability to conceptualise engineering products, processes and systems;
ability to identify, formulate and solve unfamiliar engineering problems that are incompletely defined, have competing specifications, may involve considerations from outside their field of study and non-technical - societal, health and safety, environmental and industrial/commercial - constraints, and to select and apply the most appropriate and relevant methods from established analytical, computational and experimental methods or new and innovative methods in problem solving;

ability to identify, formulate and solve problems in new and emerging areas of their specialisation.

- **Engineering Design**

The learning process should enable **Master Degree graduates to demonstrate:**

- ability to develop and design new products (devices, artefacts, etc.), processes and systems, with specifications incompletely defined and/or competing, that might require integration of knowledge from different fields and non-technical - societal, health and safety, environmental and industrial/commercial - constraints, and to select and apply established and relevant design methodologies or to use creativity to develop new and original design methodologies.

- ability to design using knowledge and understanding at the forefront of their engineering specialisation.

- **Investigations**

The learning process should enable **Master Degree graduates to demonstrate:**

- ability to identify, locate and obtain required data;

- ability to conduct searches of literature, to consult and critically use databases and other sources of information, to carry out simulation in order to pursue research or other detailed investigations of complex technical issues;

- ability to consult and apply codes of practice and safety regulations;

- advanced laboratory/workshop skills and ability to design and conduct experimental investigations, critically evaluate data and draw conclusions;

- ability to investigate the application of new and emerging technologies at the forefront of their engineering specialisation.
• **Engineering Practice**

The learning process should enable **Master Degree graduates to demonstrate:**

- practical skills, including the use of computer tools, for solving complex problems, realising complex engineering design, designing and conducting investigations;
- comprehensive understanding of applicable materials, equipment and tools, engineering technologies and processes, and of their limitations;
- comprehensive understanding of applicable techniques and methods of analysis, design and investigation and of their limitations;
- ability to integrate knowledge from different branches and to handle complexity;
- knowledge of the non-technical - societal, health and safety, environmental, industrial/commercial - implications of engineering practice.

• **Making Judgement Skills**

The learning process should enable **Master Degree graduates to demonstrate:**

- ability to work with complexity, technical uncertainty and incomplete or limited information and formulate judgements integrating knowledge;
- critical awareness of the responsibilities of engineering practice and of the impact of engineering solutions in a societal and environmental context;
- aware and motivated commitment to norms of engineering practice and professional ethics; critical awareness of economic, organisational and managerial issues (such as project management, risk and change management) of the business context.

• **Communication and Team-working Skills**

The learning process should enable **Master Degree graduates to demonstrate:**

- ability to use diverse methods to communicate clearly and unambiguously their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences in national and international contexts;
- ability to function effectively as a member or leader of a team that may be composed of different disciplines and levels in national and international contexts.
• **Lifelong Learning Skills**

The learning process should enable **Master Degree graduates to demonstrate**:

- ability to engage in independent life-long learning and to undertake further study autonomously.

**ASIIN subject-specific criteria**

Some European Agencies have formulated subject specific recommendations for programme design, like the German Agency ASIIN. They can inspire the transfer and definition of generic outcomes into discipline or subject related ones. In case of a professional accreditation programme outcomes correspond to the subject related recommendations.\(^5^3\)

### 3.2.3 Develop Learning Outcomes

**3.2.3.1 Europe**

Starting point is usually a short programme description of the programme aims, sometimes called programme educational objectives. They have to be satisfied by the detailed exit level outcomes/programme learning outcomes. In short, this can be documented by the following forms:

**Table 1: Programme Objectives**

<table>
<thead>
<tr>
<th>PROGRAMME OBJECTIVES - The graduates of the programme are prepared:</th>
</tr>
</thead>
<tbody>
<tr>
<td>O 1:</td>
</tr>
<tr>
<td>O 2:</td>
</tr>
<tr>
<td>O 3:</td>
</tr>
<tr>
<td>:</td>
</tr>
</tbody>
</table>

\(^5^3\) ASIIN, Criteria for the Accreditation of Degree Programmes, retrieved from: http://www.asiin-ev.de/media/kriterien/0.3_Criteria_for_the_Accrediation_of_Degree_Programmes_2015-12-10.pdf
Table 2: Exit Level Outcomes

<table>
<thead>
<tr>
<th>Exit Level Outcomes (ELO) - The programme graduates are able to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELO 1:</td>
</tr>
<tr>
<td>ELO 2:</td>
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<tr>
<td>ELO 3:</td>
</tr>
<tr>
<td>ELO 4:</td>
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<tr>
<td>ELO 5:</td>
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<td>ELO 6:</td>
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<tr>
<td>ELO 7:</td>
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<tr>
<td>ELO 8:</td>
</tr>
<tr>
<td>ELO 9:</td>
</tr>
<tr>
<td>ELO 10:</td>
</tr>
</tbody>
</table>

3.2.3.2 South Africa

For the accreditation of Bachelor Degree Programmes the Engineering Council of South Africa (ECSA) provides several “Forms for Use in Accreditation Visit Documentation” such as the following table: “Presentation of Evidence of Assessment of Outcomes (BEng-type programmes)”\(^{54}\).

This table is an example from BEng type programme accreditation and tries to document the alignment of intended Exit Level Outcomes and outcomes assessment. Inserting the master level outcomes it can be used for Master Degree programmes as well, describing first the fixed Exit Level Outcomes of the master programme and then considering potential and aligned assessment approaches.

Table 3: ECSA: “Presentation of Evidence of Assessment of Outcomes (BEng-type programmes)”

<table>
<thead>
<tr>
<th>ECSA Exit Level</th>
<th>Assessment Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Problem solving</td>
<td>Learning outcome: Demonstrate competence to identify, assess, formulate and solve convergent and divergent engineering problems creatively and innovatively.</td>
</tr>
<tr>
<td>• Where is outcome?</td>
<td></td>
</tr>
<tr>
<td>• How is this outcome assessed?</td>
<td></td>
</tr>
<tr>
<td>• What is satisfactory performance?</td>
<td></td>
</tr>
<tr>
<td>• What is the consequence of unsatisfactory performance?</td>
<td></td>
</tr>
<tr>
<td>2: Application of scientific and engineering knowledge</td>
<td>Learning outcome: Demonstrate competence to apply knowledge of mathematics, basic science and engineering sciences from first principles to solve engineering problems.</td>
</tr>
<tr>
<td>• Where is outcome assessed?</td>
<td></td>
</tr>
<tr>
<td>• How is this outcome assessed?</td>
<td></td>
</tr>
<tr>
<td>• What is satisfactory performance?</td>
<td></td>
</tr>
<tr>
<td>• What is the consequence of unsatisfactory performance?</td>
<td></td>
</tr>
<tr>
<td>3: Engineering Design</td>
<td>Learning outcome: Demonstrate competence to perform creative, procedural and non-procedural design and synthesis of components, systems, engineering works, products or processes.</td>
</tr>
<tr>
<td>4: Investigations, experiments and data analysis</td>
<td>Learning outcome: Demonstrate competence to design and conduct investigations and experiments.</td>
</tr>
<tr>
<td>5: Engineering methods, skills and tools, including Information Technology</td>
<td>Learning outcome: Demonstrate competence to use appropriate engineering methods, skills and tools, including those based on information technology.</td>
</tr>
<tr>
<td>6: Professional and technical communication</td>
<td>Learning outcome: Demonstrate competence to communicate effectively, both orally and in writing, with engineering audiences and the community at large.</td>
</tr>
<tr>
<td>7: Impact of Engineering activity</td>
<td>Learning outcome: Demonstrate critical awareness of the impact of engineering activity on the social, industrial and physical environment.</td>
</tr>
</tbody>
</table>
8: Individual, team and multidisciplinary working
Learning outcome: Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments.

9: Independent learning ability
Learning outcome: Demonstrate competence to engage in independent learning through well-developed learning skills.

10: Engineering Professionalism
Learning outcome: Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

11: Engineering Management
Demonstrate knowledge and understanding of engineering management principles and economic decision-making.

3.2.4 Construct Modules

In a modularised curriculum the modules represent teaching/learning provisions which through respective learning outcomes and appropriate learning and assessment activities have to ensure that the required or intended ELOs or programme outcomes are covered and achieved. In the German understanding, modules can consist of one or more courses or seminars, even provided by different teachers.

In curriculum development as well as in accreditation procedures it became common practice to use a matrix relating ELOs and module learning outcomes showing at least, to which ELOs a certain module is designed to contribute.

ECSA Form for use in Accreditation Visit Documentation:

Table 4: Course/module outcome development and assessment roles

<table>
<thead>
<tr>
<th>Code</th>
<th>Course / Module Name</th>
<th>Role of course/module in developing student toward Exit Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ELO 1</td>
</tr>
</tbody>
</table>

55 Document E-13-P in:
https://www.ecsa.co.za/education/SitePages/Education%20and%20Accreditation%20Documents.aspx
In detail the contribution of the envisaged modules to the achievement of the ELOs should be ensured by defining measurable module learning outcomes and by organising outcome assessment procedures appropriate to the intended outcomes. Detailed module/course descriptions have to provide the necessary information for students, stakeholders and external evaluators. Different forms or templates are in use at universities. We have chosen the following Course Specification Template of the Polytechnic of Namibia, now NUST, as a fairly comprehensive example.

Table 5: Course specification template

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Provide full title of the course.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Code</td>
<td>Provide the relevant course Code.</td>
</tr>
<tr>
<td>NQF Level</td>
<td>Provide the NQF level of the learning outcomes of the specific course in terms of the complexity of learning as aligned to the ten (10) levels of NQF.</td>
</tr>
<tr>
<td>Notional Hours</td>
<td>Provide the total minimum hours of learner effort including lectures, seminars, practical work, independent study, group work, assignments, research, exams, etc. 1 credit = 10 notional hours.</td>
</tr>
<tr>
<td>NQF Credits</td>
<td>Provide the minimum NQF credits of the specific course.</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>Provide a list of requirements or courses that should first be completed before this one.</td>
</tr>
<tr>
<td>Options (compulsory or elective)</td>
<td>State whether the course is compulsory or elective. Compulsory courses represent essential skills while elective courses represent complementary or specialist skills.</td>
</tr>
<tr>
<td>Semester Offered</td>
<td>State the semester in which the course is offered and duration. e.g. 1/2</td>
</tr>
<tr>
<td>Course Aims</td>
<td>Provide overarching aims of the course and how it fits within the programme, e.g. The aims for this course are set into the context of the course aims to:</td>
</tr>
</tbody>
</table>

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56 Polytechnic of Namibia, The Curriculum Framework, November 2009
| **Learning Outcomes/Specific Outcomes** | Provide specific course learning outcomes of a students’ knowledge, abilities and skills after successful completion of the course. Learning outcomes should sufficiently cover the course content. They should include functional verb(s), standard and the degree of autonomy of learning.  
  
  *e.g. On completing the course students should be able to:*  
  
  (number each learning outcome). Learning outcomes should be aligned with the specifications of NQF level descriptors for the particular level. |
| **Course Content** | Provide a brief description of course content and an outline of the topics covered in the course. |
| **Methods of Facilitating Learning** | List and describe teaching and learning activities that will take place within the course, e.g. laboratory activities, lectures, tutorials, projects, field trips, etc. Teaching and learning strategies should be student-centered and aligned with the course learning outcomes.  
  
  *e.g. The course will be facilitated through the following learning activities:* |
| **Assessment Strategies** | List the types of assessment (e.g. written exams, oral, continuous assessment, thesis, etc.), components and weighting (%), and minimum mark (%) to be achieved in order to pass the course. Describe the evidence the student will have to provide proof of competence, describe the standard/quality of the expected performance and the criteria that will be used by the assessor to determine whether the student have achieved the specific outcomes of the course. Assessment strategies should be aligned with the course learning outcomes. |
| **Quality Assurance Arrangements** | Outline the methods for evaluating and improving the quality and standards of teaching and learning, e.g. programme review, external examiner and/or moderation, student evaluation, etc. |
| **Student Support and Learning Resources** | Provide a brief statement of student support both at Polytechnic and the School and/or course level, e.g.  
  
  - **Polytechnic level:** the library, student services  
  - **School level:** school-based induction, learning support units, tutor systems  
  - **Course level:** print and electronic learning resources (text books, modules, websites) and tutor services – break this into Prescribed and Recommended Learning Resources  
  
  *(ensure that all resources, including electronic sources, are fully and correctly referenced)* |
3.2.5 Teaching/Learning Arrangements and Methods

Professional accreditation does not ask for details of teaching/learning arrangements but leaves it to the programme providers and the involved teaching staff what kind of delivery and learning environment they find appropriate for their students in order to achieve required or intended outcomes. For South Africa’s and Namibia’s approval and state accreditation it is however an issue. And for the curriculum design and implementation at the university it is a crucial part of the alignment process to identify and choose the most appropriate, effective and efficient teaching/learning methods and arrangements.

Some countries require a certain mix of learning situations, assigning a minimum number of credits to different learning situations like compulsory courses and electives, internships, study abroad, project work, final thesis or dissertation. A few requirements and references are given here:

<table>
<thead>
<tr>
<th>HEQC - Criterion 5 - Teaching and Learning Strategy</th>
</tr>
</thead>
</table>

The institution gives recognition to the importance of promoting student learning. The teaching and learning strategy is appropriate for the institutional type (as reflected in its mission), mode of delivery and student composition, contains mechanisms to ensure the appropriateness of teaching and learning methods, and makes provision for staff to upgrade their teaching methods. The strategy sets targets, plans for implementation and mechanisms to monitor progress, evaluate impact and effect improvement.

Figure 11: HEQC-Criterion 5
### Table 6: ECSA: Forms for Use in Accreditation Visit Documents: Document E-13-P: Table: Programme structure and Course/module details\(^7\)

<table>
<thead>
<tr>
<th>Course/Module</th>
<th>Time Units and Total Contact</th>
<th>HEQSF Credits</th>
<th>Knowledge Area Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lecture (L)</td>
<td>Tutorial (T)</td>
<td>Laboratory (P)</td>
</tr>
<tr>
<td>Code Name</td>
<td>(T_{L}=)</td>
<td>(T_{T}=)</td>
<td>(T_{P}=)</td>
</tr>
<tr>
<td>Semester 1: Compulsory Courses/Modules</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semester 1: Electives: x number/credits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semester 2: Compulsory Courses/Modules</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semester 2: Electives: x number/credits</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total for programme including required number of credits for electives

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\(^7\) Document E-13-P in: https://www.ecsa.co.za/education/SitePages/Education%20and%20Accreditation%20Documents.
3.2.6 Assessment

Appropriate outcomes assessment approaches providing evidence to what extent required or intended outcomes have been achieved and contributing to a continuous feedback and quality improvement system are crucial. They are of central importance for successful curriculum design and implementation as well as for state and even more for professional accreditation. Respective requirements and approaches can be found in different official documents, even if it is mainly the programme provider who has to decide about the approaches. A basic tool for providing evidence is the assessment of module/course learning outcomes. They have to take place anyway to arrive at individual performance and level of attainment and respective grading. Besides the usual module/course related examination and grading procedures there have to be additional measures of assessment for providing evidence of programme outcomes achievement. In professional accreditation procedures certain additional provisions of evidence may even be required, e.g. regular questionnaires asking students, graduates and employers. For these purposes it is helpful to not only design a curriculum but also explicitly an assessment plan, which specifies and schedules systematic assessment activities, not only for accreditation and accountability purposes but also for “closing the loop” in a continuous process of quality enhancement.

South Africa:

HEQC – Criterion 6 - Assessment

The different modes of delivery of the programme have appropriate policies and procedures for internal assessment, internal and external moderation, the monitoring of student progress, explicitness, the validity and reliability of assessment policies, the recording of assessment results, the settling of disputes, the rigor and security of the assessment system, Recognition of Prior Learning (RPL) and the development of staff competence in assessment.

Figure 12: HEQC-Criterion 6
<table>
<thead>
<tr>
<th>Course/Module identification</th>
<th>Teachers * = co-ordinator</th>
<th>Assessment Components: Type and Duration</th>
<th>3-year Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Code</td>
<td>Name</td>
<td>1</td>
</tr>
<tr>
<td>Semester 1: Compulsory Courses/Modules</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Semester 1: Electives: x courses/credits</td>
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<tr>
<td>Semester 2: Compulsory Courses/Modules</td>
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<tr>
<td>Semester 2: Electives: x courses/credits required</td>
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</tbody>
</table>

Table 7: ECSA: Forms for Use in Accreditation Visit Documents: Document E-13-P: Table: Course/Module Assessment Details

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58 Document E-13-P in: https://www.ecsa.co.za/education/SitePages/Education%20and%20Accreditation%20Documents
Europe:

The new EUR-ACE Framework Standards and Guidelines address assessment under “Teaching and Learning Process” in paragraph 2.3.2 as follows:

**Teaching and Learning Process**

“The teaching and learning process must enable engineering graduates to demonstrate the knowledge, understanding, skills and abilities specified in the programme outcomes. The programme curriculum must specify how this is to be achieved.

The curriculum should give comprehensive information on all the modules in the degree programme, including the syllabus, the module learning outcomes, the methodology of teaching and learning, credit allocation, the method of module assessment, and any pre-requisite or co-requisite modules or other programme requirements. The curriculum should ensure that the module learning outcomes aggregate to the programme learning outcomes, including the effect of student choice of modules.

The learning process should be sufficiently flexible to accommodate different entry qualifications of students and different learning styles. If the programme includes time spent in industry or in another HEI, it should be assessed in the context of its contribution to the achievement of the programme outcomes.

The assessment of students should evaluate achievements of the specified module learning outcomes, and be both rigorous and fair. Wherever possible there should be second marking of student work or moderation of assessments. Students should have an opportunity to redeem work that is assessed as being below standard, provided this can be done without compromising output standards.

Independent and external scrutiny of the assessment of students, and of the decisions on progress and completion, are effective in ensuring that output standards are maintained. The arrangements for any such scrutiny should be documented.”
Assessing the achievement of course and programme learning outcomes requires to carefully align the intended outcomes with the appropriate assessment measures. The full range of existing methods should be employed. With regard to learning outcomes of modules not only summative but also formative assessments should be used. In case of certain graduate outcomes like attitudes and values, team and leadership abilities, professional handling of complex situations it is often not possible or reasonable to base the evaluation only on exams or student performance in courses. Accordingly, besides direct also indirect methods should be used. It can comprise:

<table>
<thead>
<tr>
<th>Direct</th>
<th>Indirect</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Standardised exams</td>
<td>• Written surveys and questionnaires</td>
</tr>
<tr>
<td>• Locally developed exams</td>
<td>• Exit and other interviews</td>
</tr>
<tr>
<td>• Portfolios</td>
<td>• Archival record</td>
</tr>
<tr>
<td>• Simulations</td>
<td>• Focus groups</td>
</tr>
<tr>
<td>• Performance Appraisal</td>
<td></td>
</tr>
<tr>
<td>• External examiner</td>
<td></td>
</tr>
<tr>
<td>• Oral exams</td>
<td></td>
</tr>
<tr>
<td>• Behavioral observations</td>
<td></td>
</tr>
</tbody>
</table>

Professional Accreditation asks for evidence of outcomes achievement, not for levels of attainments or grades, only occasionally for retention rates or percentage of drop outs caused by not passing exams. But some tools commonly used to facilitate reliable and valid grading can also be helpful for demonstrating the achievement of learning outcomes in detail as well as for identifying weaknesses in student learning and competence achievement. They can thus contribute to improvement, e.g. concept maps and rubrics. Two types of rubrics are in use:

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61 Ciechanowska, D., Facilitating student development in the self-directed approach to learning, retrieved from: Dorota Ciechanowska, academia edu.
- holistic rubrics and
- analytical rubrics.

Both require specifications of what kind of knowledge, skills, product deliverables, performances, behavior or attitudes have to be presented to prove that a certain outcome is achieved. In holistic rubrics each of the chosen criteria is scored directly. In analytic rubrics it is further defined what kind of demonstration per criterion is expected for which level of attainment.

Analytical rubrics with criterion-referenced demonstrations of student achievement and scores may be used:

- To determine whether students have learned expected knowledge and skills. If the criterion-referenced tests are used to make decisions about grade promotion or diploma eligibility, they would be considered “high-stakes tests.”
- To determine if students have learning gaps or academic deficits that need to be addressed.
- To evaluate the effectiveness of a course, academic programme, or learning experience, e.g. by using “pre-tests” and “post-tests” to measure learning progress over the duration of the instructional period.
- To evaluate the effectiveness of teachers by factoring test results into job-performance evaluations.
- To measure progress toward the goals and objectives described in an “individualized education plan” for students with disabilities.
- To determine if a student or teacher is qualified to receive a license or certificate.
- To measure the academic achievement of students in a given state, usually for the purposes of comparing academic performance.
- To measure the academic achievement of students in a given country, usually for the purposes of comparing academic performance among nations, like e.g. the OECD PISA test.
- To provide evidence how a certain cohort of students performed against required outcomes of a course or programme and whether they met threshold standards, as expected for instance in peer evaluations of accreditation activities.

https://www.academia.edu/9918434/Facilitating_student_development_in_the_self-directed_approach_to_learning
For the PEESA project programmes, the use of analytical rubrics would not only facilitate valid and reliable scoring but contribute to a transparent learning and assessment process of the involved students and to systematic quality evaluations and quality management, apart from review or accreditation requirements.

The following example, applied to the learning outcome “work effectively in teams” may illustrate the structure and advantage of an analytical rubric.

![Figure 13: Example of an Analytic Rubric](image)

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Rogers, Gloria, Developing Rubrics, 2010
The Association of American Colleges and Universities (AAC&U) started an initiative to develop and test rubrics on central learning outcomes for undergraduate degrees which can be

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64 American Society for Engineering Education, 2012: AC 2012-4488: Evolving a rubric for use in assessing engineering graduate attributes in a student senior research thesis
used by HEIs and by programme providers and teaching staff as a reference for constructing their own rubrics. It was based on the experience, that for many of the programme outcomes—Intellectual and Practical Skills, Personal and Social Responsibility, and Integrative and Applied Learning—few useful assessments of student learning existed. In response, AAC&U conceived and initiated a new approach to assessing these three strands of the Essential Learning Outcomes based upon authentic student work from the curriculum and co-curriculum and rubrics designed to probe the quality of that work. This new approach, entitled Valid Assessment of Learning in Undergraduate Education, or VALUE, began in 2007. The rubrics, developed by voluntary teams of faculty, have been tested on many campuses and revised as far as necessary. Since the initial release of the rubrics in 2009, thousands of campuses and individuals in the United States and around the world have used the VALUE rubrics in various ways to meet student learning and assessment needs in their departments, programs, or institutions. Meanwhile a third version of the rubrics is available for free. The rubrics continue to function as highly appreciated tools and references for improving assessment and grading of learning outcomes, but can also serve required as a tool for specifying intended learning outcomes.

“The following learning outcomes have been addressed:

- civic engagement
- creative thinking
- critical thinking
- ethical reasoning
- foundations and skills for lifelong learning
- information literacy
- inquiry and analysis
- integrative and applied learning
- intercultural knowledge and competence
- oral communication
- problem solving
• quantitative literacy
• reading
• teamwork
• written communication.

The process resulted in the creation of 15 VALUE rubrics (A 16th VALUE rubric, focused on global learning, was released in 2013.) The access is for free. Teaching staff or programme developers using them may take only a selected number of the rubrics for adaptation to their own needs. As the rubrics are not subject-specific some of them have to be anyway enriched by subject specific aspects. If they are used for master level outcomes, an adaptation with reference to higher levels of attainment is also needed.

3.2.7 Support Materials

This step in the curriculum design flow chart of VUT is the final one in the curriculum design process, before other issues of the programme design and internal and external processes of approval and accreditation/registration are tackled. Information on this topic has to be provided in South Africa for programme approval and state accreditation.

If it goes beyond student advice and support services and covers facilities and staff it is usually addressed by separate topics of the programme design and implementation process, like available physical, personal and financial resources as well as programme and quality management. For that reason we – in the following paragraphs 3.3 to 3.5 – have listed the requirements for admission, resources and quality assurance by the EUR-ACE Framework Standards and Guidelines. It is obvious from the HEQC requirements that these information and respective documents must be provided for state approval and accreditation of programmes in South Africa and Namibia as well. Satisfactory information on these topics will be an issue also for the accreditation procedures of ASIIN or other ENAEE authorised

agencies for the award of the EUR-ACE label, as indicated in the following quotations. The topic 3.5 “Internal Quality Assurance” will be discussed in more detail.

3.3 Admission

**HEQC – Criterion 2 – Student Recruitment, Admission and Selection**

Recruitment documentation informs potential students of the programme accurately and sufficiently, and admission adheres to current legislation. Admission and selection of students are commensurate with the programme’s academic requirements, within a framework of widening access and equity. The number of students selected takes into account the programme’s intended learning outcomes, its capacity to offer good quality education and the needs of the particular profession (in the case of professional and vocational programmes).

*Figure 15: HEQC-Criterion 2*

**EUR-ACE Framework Standards and Guidelines, paragraph 4.4:**

“The criteria for student admission, transfer, progression and graduation must be clearly specified and published, and the results monitored”.

Students should be informed of the qualifications necessary to enter the programme and of the regulations necessary to progress to completion. The criteria for students to transfer into later stages of the programme should be clearly specified.

Records of student achievement provide essential information for the review and development of programmes. There should be arrangements for monitoring the progress of students through the programme against their entry qualifications, so as to provide essential data for reviewing entry to the programme. In particular the number of, and reasons for, non-completions should be recorded. The overall performance of students in individual modules
should be noted in order to identify assessment results that are significantly different from the norm.\footnote{ENAE, EAFSG, 2015, retrieved from; http://www.enaee.eu/eur-ace-system/eur-ace-framework-standards/standards-and-guidelines-for-accreditation-of-engineering-programmes/}

Admission policy and enrolment of well qualified and capable students for master programmes play an important role in ENAEE EUR-ACE professional accreditation. This is due to the fact that many of the programme outcomes on master level are based on (or are extensions of) outcomes of the undergraduate level and the respective entrance qualifications. It has been stated in this paper and discussed in the PEESA workshops, that usually a Level 8 qualification in the matching subject area would satisfy the admission requirements for the new Level 9 master programmes. However, there may be exceptions for applicants with comparable qualifications or recognized prior learning knowledge and skills. In this case, the diversity of the enrolled cohort of students will increase and may require additional measures to equalize student knowledge and skills or differentiate the teaching/learning provisions of the programme accordingly. Programme providers should be prepared for respective questions in professional accreditation procedures and should anyway care how they address diversity.
3.4 Resources

<table>
<thead>
<tr>
<th>HEQC – Criterion 3 – Staff Qualification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic staff responsible for the programme are suitably qualified and have sufficient relevant experience and teaching competence, and their assessment competence and research profile are adequate for the nature and level of the programme. The institution and/or other recognised agencies contracted by the institution provide opportunities for academic staff to enhance their competences and support their professional growth and development.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HEQC – Criterion 4 - Staff Size and Seniority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic staff responsible for the programme are suitably qualified and have sufficient relevant experience and teaching competence, and their assessment competence and research profile are adequate for the nature and level of the programme. The institution and/or other recognised agencies contracted by the institution provide opportunities for academic staff to enhance their competences and support their professional growth and development.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HEQC – Criterion 7 - Infrastructure and Library Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suitable and sufficient venues, IT infrastructure and library resources are available for students and staff in the programme. Policies ensure the proper management and maintenance of library resources, including support and access for students and staff. Staff development for library personnel takes place on a regular basis.</td>
</tr>
</tbody>
</table>

Figure 16: HEQC-Criterion 3, 4, 7

EUR-ACE Framework Standards and Guidelines, paragraph 4.3:

“The resources to deliver the programme must be sufficient to enable the students to demonstrate the knowledge, understanding, skills and abilities specified in the Programme Outcomes”.

The number, qualifications and experience of the teaching staff should be adequate to teach the programme to the standard specified in the programme outcomes. The programme should be supported by an effective team of technical and administrative staff. There should be arrangements in place for ensuring that staff are updated to use and apply new technologies
and receive training as and when required. The laboratory, computing and workshop facilities should have the equipment necessary to support the programme; the arrangements for safe access by students should ensure appropriate opportunities for student practical activities, particularly to support project work.

Student support services, including but not limited to, tutoring, library and other information resources, assistance with external placements, should be readily accessible by students.

The resources necessary to deliver the programme should be supported by an adequate budget.\(^6\)

It is trivial that satisfactory resources are necessary to run a programme. In professional programme accreditation it would be taken for granted that the state accreditation would only allow to implement the programme and admit students if respective resources are or will be available. Contrary to the South African state accreditation of programmes, taking place before a programme can be implemented and started, professional accreditation is an ex-post procedure after at least one cohort of students has graduated from a programme. It can rely on empirical data and experience. The focus of inquiry and peer evaluation usually is, whether the resources have been adequate and in particular, whether they will be sustainable so that required level of outcomes will be achieved also in the future, at least for the period until re-accreditation, usually 6 years. Evidence has to be provided that an adequately qualified amount of staff on tenure will contribute to the programme and that also part time staff, hired from industry or research institutes, is properly experienced and prepared for their education and training and student assessment activities. A staff development process should be in place.

3.5 Internal Quality Assurance

EUR-ACE Framework Standards and Guidelines, paragraph 4.5

In the EAFSG it is stated:

“Engineering degree programmes must be supported by effective quality assurance policies and procedures”.

The programme should have quality assurance procedures that are consistent with the HEI quality assurance policy. It would be expected that there is a defined and documented procedure for reviewing the programme at regular intervals using all relevant data, including an evaluation of student achievements against the stated programme aims.

Feedback should be obtained in an agreed format from the students on an accredited programme on all taught modules in the programme, to enable the effectiveness of each module to be evaluated. There should be clearly understood arrangements for the day to day management of the programme to resolve any urgent and immediate problems. Information about all aspects of the programme, including the quality assurance procedures, should be publicly available.\textsuperscript{68}

For HEIs in the European Higher Education Area (EHEA) the “European Standards and Guidelines for Quality Assurance in Higher Education” (ESG) will be taken into account.

The ESG, explained in paragraph 1.5 of this contribution, are considered and addressed in the EUR-ACE FSG as well as by agencies authorised by ENAEE to award the EUR-ACE labels. They describe minimum requirements for internal and external quality assurance, affecting structures of quality management as well as processes. In paragraph 1.5 the structure of a possible comprehensive HEI Quality Management System has already been exemplified, using the concept of the Namibian University of Science and Technology (NUST).

Regarding processes and the above quoted EAFSG expectation “that there is a defined and documented procedure for reviewing the programme at regular intervals using all relevant data, including an evaluation of student achievements against the stated programme aims” it is worthwhile and recommended to – at an early stage of the programme implementation and execution – develop an overall assessment plan. As already stated, the regular and day to day assessment and grading of students is not sufficient for running an efficient quality management system and for providing evidences for programme review or professional accreditation purposes. Additional measures have to be taken. Data have to be collected from different sources, but should only be asked for if they are really useful for accountability reasons or for continuous quality enhancement activities. However, it is not necessary to collect all relevant data every semester. A comprehensive assessment plan determines what kind of data will be collected by whom at what time by which kind of measures and for what purposes.

In connection with the shift from in-put to outcomes based education and related professional accreditation of programmes it was ABET, the USA Agency for Professional Accreditation of Engineering and Technology programmes, which promoted the use of assessment plans to gather useful information for the provision of evidence that required outcomes are achieved. An example for a three year cycle and the related activities to assess and evaluate the six transferable skills of the ABET Criterion 3 outcomes list is given in the following figures.
**Figure 17:** Three-year-cycle of assessment and evaluation activity

![Table showing activities over three years](https://www.abet.org/wp-content/uploads/2015/04/establish-assess-timelines-responsibilities-2.pdf)

**Figure 18:** Assessment and evaluation activity timeline for a single outcome

![Table showing activities for a single outcome](https://www.abet.org/wp-content/uploads/2015/04/establish-assess-timelines-responsibilities-2.pdf)

---


An example of a more comprehensive assessment plan is shown in the following figure. It was developed for a master programme implementation at Tomsk Polytechnic University, Russia, in the context of the ECD-EAST project:

<table>
<thead>
<tr>
<th>Assessment Level</th>
<th>Activities</th>
<th>Purpose</th>
<th>Periodicity</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programme Objectives</td>
<td>Employers Survey</td>
<td>To gather feedback from employers on the quality of the graduates performance and on the relevance and importance of the programme objectives</td>
<td>Annually</td>
<td>Faculty / Working group, Job Placement Office, Office for Social Surveys</td>
</tr>
<tr>
<td></td>
<td>Alumni Survey</td>
<td>To gather feedback from alumni on their employment status and career</td>
<td>Annually</td>
<td>Faculty / Working group, Job Placement Office, Office for Social Surveys</td>
</tr>
<tr>
<td></td>
<td>Meeting of Working group on assessment of programme objectives</td>
<td>Evaluation of feedback obtained from employers, alumni and other sources. Elaboration of proposals for improvement of the programme objectives.</td>
<td>Annually</td>
<td>Working group / Programme Coordinator</td>
</tr>
<tr>
<td></td>
<td>Department meeting on the assessment of programme objectives</td>
<td>Review and approval of the new programme objectives</td>
<td>Once in 3-5 years</td>
<td>Faculty</td>
</tr>
<tr>
<td>Programme Learning Outcomes</td>
<td>Graduating Students Survey</td>
<td>To gather feedback from graduating students on their achievement of the learning outcomes and the quality of the education they received.</td>
<td>Annually</td>
<td>Faculty, Job Placement Office, Office for Social Surveys</td>
</tr>
<tr>
<td></td>
<td>Internship Supervisors Survey</td>
<td>To gather feedback from supervisors on student performance and their achievement of the learning outcomes</td>
<td>Annually</td>
<td>Working group / Programme Coordinator</td>
</tr>
<tr>
<td></td>
<td>Faculty Survey, including members of State Attestation Commission</td>
<td>To gather feedback from faculty on students’ achievement of the learning outcomes</td>
<td>Annually</td>
<td>Working group / Programme Coordinator</td>
</tr>
<tr>
<td></td>
<td>Meeting of Working group on assessment of learning outcomes</td>
<td>Evaluation of feedback obtained from graduating students, internship supervisors, faculty and other sources. Elaboration of proposals for improvement of the programme learning outcomes.</td>
<td>Annually</td>
<td>Working group / Programme Coordinator</td>
</tr>
<tr>
<td></td>
<td>Department meeting on assessment of Learning outcomes</td>
<td>Review and approval of the new programme learning outcomes</td>
<td>Once in 1-3 years</td>
<td>Faculty</td>
</tr>
<tr>
<td>Module Learning Outcomes</td>
<td>Students Survey</td>
<td>To gather feedback on the achievement by students of the module learning outcomes (within all or selected modules or courses)</td>
<td>Each Semester</td>
<td>Course instructors</td>
</tr>
<tr>
<td></td>
<td>Meeting of Working group on assessment of modules (courses) learning outcomes</td>
<td>Evaluation of feedback got from students and other sources. Review and approval of the new module learning outcomes with course instructors</td>
<td>Annually</td>
<td>Working group / Programme Coordinator</td>
</tr>
</tbody>
</table>

Figure 19: Example Assessment plan

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## Annexes and Links

### Appendix 1 – Curriculum Design Process (Guidelines for Developing a Programme – Vaal University of Technology)

VUT template used for checking the fulfilment of required steps, in this case for the DHET approval of the new PEESA project master programme in engineering (energy efficiency).

The HEQF and the criteria for programme accreditation available from the VUT Department Curriculum Development should form an integral part in developing programmes.

**Programme design and organisation should include the following aspects:**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>YES</th>
<th>NO</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The specification of admission requirements, including arrangements and criteria for Recognition of Prior Learning (RPL)</td>
<td>Yes</td>
<td></td>
<td>RPL Policy (Annexure G)</td>
</tr>
<tr>
<td>• The specification of Intended Learning Outcomes (ILO’s) in terms of desired knowledge, skills, values and attitudes of programme graduates</td>
<td>Yes</td>
<td></td>
<td>(Annexure A)</td>
</tr>
<tr>
<td>• The selection and organisation of the programme content, including the sequencing of the modules and the determination of the fundamental, core and elective modules as well as other possible programme elements.</td>
<td>Yes</td>
<td></td>
<td>(Annexure A)</td>
</tr>
<tr>
<td>• The design of the learning experience, which entails the selection of teaching and learning approaches, educational technologies and the strategies for learner support, in accordance with programme’s Intended Learning Outcomes (ILO’s)</td>
<td>Yes</td>
<td></td>
<td>The programme is modularised and each module is structured to purpose. (Annexure A) (Annexure C)</td>
</tr>
<tr>
<td>• The planned arrangements for work integrated learning, including workplace learning, field-trips and internships.</td>
<td>No</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>• The selection of assessment methods and the stipulation of the assessment criteria as a means of establishing the extent to which a learner achieve the Intended Learning Outcomes (ILO’s)</td>
<td>Yes</td>
<td></td>
<td>Assessment methods conform to ILO’s and ELO’s. (Annexure A)</td>
</tr>
</tbody>
</table>
• The specification of performance indicators for the programme, including module pass rates, throughput rates and graduation rates.  

<table>
<thead>
<tr>
<th>ITEM</th>
<th>YES</th>
<th>NO</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conform to VUT requirements</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

• Indication of how the programme was benchmarked  

<table>
<thead>
<tr>
<th>ITEM</th>
<th>YES</th>
<th>NO</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benchmarking is done against ECSA criteria agreed under international accord. (Annexure B, 4.2) (Annexure C) Doc C</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In developing proposals for new academic programmes, attention should be given to:

**Strategic importance of the programme**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>YES</th>
<th>NO</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alignment with the vision of the institution and the faculty</td>
<td>Yes</td>
<td>Academic planning (Annexure A) (Annexure D)</td>
<td></td>
</tr>
<tr>
<td>The institution’s PQM and CESM – definition categories as approved by DoHET</td>
<td>Yes</td>
<td>Doc B (Annexure A)</td>
<td></td>
</tr>
<tr>
<td>Relation to existing provision in the Department and the University</td>
<td>Yes</td>
<td>Doc A + Doc F</td>
<td></td>
</tr>
<tr>
<td>Delivery mode of the programme</td>
<td>Yes</td>
<td>Full Time Contact Doc F</td>
<td></td>
</tr>
<tr>
<td>Contribution to focal areas of the faculty</td>
<td>Yes</td>
<td>(Annexure A)</td>
<td></td>
</tr>
<tr>
<td>Responsiveness and relevance to local, regional and national needs (Equity and access opportunities for previously marginalized groups)</td>
<td>Yes</td>
<td>Advisory Board Doc F + Doc A (Annexure B+C)</td>
<td></td>
</tr>
<tr>
<td>Engagement with students and the broader community</td>
<td>Yes</td>
<td>Advisory Board Doc F + Doc A (Annexure B+C)</td>
<td></td>
</tr>
</tbody>
</table>

**Internal requirements**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>YES</th>
<th>NO</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DoHET requirements for qualification development, funding and PQM clearance</td>
<td>Yes</td>
<td>DoHET registration Doc F</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doc F</td>
<td>Doc F</td>
<td>DoHET registration</td>
</tr>
</tbody>
</table>

99
- HEQC criteria for programme accreditation
  
  - SAQA registration requirements
    Yes
  
  - The requirements of the Higher Education Qualifications Framework in keeping with national and international standards, including general qualification standards as specified in the level descriptors, qualification type descriptors, generic qualification standards and specific qualification standards
    Yes
  
  Professional body requirements where applicable
  Yes
  N/A

### Resource implications/sustainability of programmes

<table>
<thead>
<tr>
<th>ITEM</th>
<th>YES</th>
<th>NO</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational requirements and institutional capacity and infrastructure</td>
<td>Yes</td>
<td></td>
<td>HEQF aligned qualification</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Doc A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Annexure A)</td>
</tr>
<tr>
<td>Financial considerations (Start-up costs) determined by business plan and detailed market research or needs analysis</td>
<td>Yes</td>
<td></td>
<td>DoHET registration</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PEESA project</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Annexure C)</td>
</tr>
<tr>
<td>Locality of the campus infrastructure and facilities</td>
<td>Yes</td>
<td></td>
<td>Existing</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Doc F</td>
</tr>
<tr>
<td>Current availabilities for the programme INCLUDING financial, library and human resources (Suitably qualified and experienced staff in the DESM categories and requirements for additional support staff)</td>
<td>Yes</td>
<td></td>
<td>Existing</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Doc F</td>
</tr>
<tr>
<td>Requirements for additional staff development and training</td>
<td>Yes</td>
<td></td>
<td>Requirement planning done</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Doc C</td>
</tr>
<tr>
<td>Additional space requirements for teaching or other purposes (Consider maximum class size)</td>
<td>Yes</td>
<td></td>
<td>Doc A</td>
</tr>
<tr>
<td>Past enrolment trends particularly if the application is for a new programme that builds on a lower level programme</td>
<td>Yes</td>
<td></td>
<td>B-Tech students and New</td>
</tr>
<tr>
<td>Demonstrated need for a programme as illustrated</td>
<td>Yes</td>
<td></td>
<td>Doc A</td>
</tr>
</tbody>
</table>
by the programme demand, which is determined by investigations into the apparent needs of a local community and preferences of school leavers and students (Annexure C)

### Academic standards and integrity

<table>
<thead>
<tr>
<th>ITEM</th>
<th>YES</th>
<th>NO</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programme design</td>
<td>Yes</td>
<td></td>
<td>(Annexure A)</td>
</tr>
<tr>
<td>Learning outcomes and contributions to achievement of programme purpose; assessment methods and criteria</td>
<td>Yes</td>
<td></td>
<td>Outcomes defined (Annexure A)</td>
</tr>
<tr>
<td>Teaching and learning interactions</td>
<td>Yes</td>
<td></td>
<td>Experienced staff (Annexure A) Doc F</td>
</tr>
<tr>
<td>Proposed modules linked to faculties</td>
<td>Yes</td>
<td></td>
<td>Existing services</td>
</tr>
<tr>
<td>Alignment of modules with the programmes</td>
<td>Yes</td>
<td></td>
<td>International Collaboration under EU aligned (Annexure C) Doc F</td>
</tr>
<tr>
<td>Duplication or overlap with other programmes</td>
<td>Yes</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>Internal comparability and articulation possibilities</td>
<td></td>
<td></td>
<td>ACSA accredited Doc A + Doc F</td>
</tr>
<tr>
<td>Credit allocation per module</td>
<td>Yes</td>
<td></td>
<td>HEQF aligned (Annexure A)</td>
</tr>
<tr>
<td>Total NQF credits per programme</td>
<td>Yes</td>
<td></td>
<td>HEQF aligned (Annexure A)</td>
</tr>
<tr>
<td>HEQF levels of the programme</td>
<td>Yes</td>
<td></td>
<td>HEQF aligned Doc F (Annexure A)</td>
</tr>
<tr>
<td>Use of ICT – enhanced learning facilities</td>
<td>Yes</td>
<td></td>
<td>HEQF aligned Mixed mode</td>
</tr>
</tbody>
</table>
## Appendix 2 – German Examples of Good Practice: Programmes on Renewable Energy and Energy Efficiency

<table>
<thead>
<tr>
<th>Programme</th>
<th>Postgraduate Programme Renewable Energy (PPRE)</th>
<th>Renewable Energies and Energy Efficiency for the Middle East and North Africa Region (REMEENA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEI</td>
<td>University Oldenburg, Germany</td>
<td>University Kassel, Germany; University Cairo, Egypt</td>
</tr>
<tr>
<td>Degree</td>
<td>Master of Science (M.Sc.)</td>
<td>Double Degree International Master of Science (M.Sc.)</td>
</tr>
</tbody>
</table>

### Overview Program Structure

<table>
<thead>
<tr>
<th>Duration</th>
<th>18 months</th>
<th>21 months full-time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6 months at CU, Egypt</td>
<td>6 months at UKAS, Germany</td>
</tr>
<tr>
<td></td>
<td>9 months master project with an institution/company in the MENA region</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Entry Requirements</th>
<th>Bachelor degree</th>
<th>Bachelor degree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Proven language proficiency in English</td>
<td>Practical experience in the energy sector</td>
</tr>
<tr>
<td></td>
<td>Application oriented</td>
<td>Proven language proficiency in English</td>
</tr>
<tr>
<td></td>
<td>Science oriented</td>
<td></td>
</tr>
</tbody>
</table>

### Syllabus

#### Qualification Modules

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Modules</th>
<th>Modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>49</td>
<td><strong>Renewable Energy Basic</strong></td>
<td><strong>Engineering Thermodynamics</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Wind Energy</strong></td>
<td><strong>Heat Transfer</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Solar Energy</strong></td>
<td><strong>Fluid Mechanics</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Energy Meteorology &amp; Storage Technologies</strong></td>
<td><strong>Material Science</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Biomass &amp; Hydro Energy</strong></td>
<td><strong>Electrical Engineering Fundamentals</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Energy Systems &amp; Society</strong></td>
<td><strong>Control Systems</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Case Study</strong></td>
<td><strong>Technical Mechanics</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Engineering Mathematics</strong></td>
</tr>
</tbody>
</table>

#### Compulsory Modules

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td><strong>Specialisation</strong></td>
</tr>
<tr>
<td></td>
<td><strong>External Practical Training</strong> (Semester Break)</td>
</tr>
</tbody>
</table>

#### Elective Modules

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td><strong>Solar Energy Devices</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Bio Energy</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Development of Renewable Energy Projects</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Solar Energy Systems</strong></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Master Thesis</td>
<td>Wind Energy Technology</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>30 ECTS</td>
<td></td>
</tr>
<tr>
<td><strong>Total Workload</strong></td>
<td></td>
</tr>
</tbody>
</table>
### 1. Programme Aims

#### 1.1 Educational needs of the labour market and other stakeholders

**Documentation to be provided**
- Relevant industry and labour market organisations and other stakeholders consulted, and methods and schedule of consultation.
- Identified educational needs of the labour market and other stakeholders.

**Questions to be considered**
- Were the relevant industry and labour market organisations and other stakeholders consulted? Was the methodology and schedule of consultation adequate in order to identify their educational needs?
- Have the educational needs of these stakeholders been identified in a way which facilitates the definition of the programme aims and programme outcomes, i.e. in terms of professional profiles and/or functions/roles/activities expected of the graduates and associated required competences?

#### 1.2 Programme Aims

**Documentation to be provided**
- Set of Programme Aims

**Questions to be considered**
- Have the programme aims been developed in terms of professional profiles of the engineering graduates and/or roles/activities students are to be prepared for, and the associated competences to be developed and obtained by the students during the learning process?
- Are the programme aims consistent with the mission of the institution that the programme belongs to and the identified educational needs of the labour market?

#### 1.3 Programme outcomes

**Documentation to be provided**
- Set of programme outcomes.

**Questions to be considered**
- Have the programme outcomes been established in terms of what students are expected to know, understand and/or be able to demonstrate after completion of the learning process?
- Are the programme outcomes consistent with the relevant national qualifications framework, if any, with the EUR-ACE® Programme Outcomes for accreditation and with the established programme aims?

### 2.1 Teaching and Learning Process

**Documentation to be made available / to be required**
- Curriculum and description of its characteristics.
- Characteristics of the modules/course units (in particular: number of ECTS credits, learning

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outcomes, content, typologies of teaching activities, assessment of students’ learning, pre-requisites, didactic material). Documentation of the suitability of the curriculum to the achievement of the programme outcomes.

**Questions to be considered**

Does the totality of the learning outcomes of the modules accumulate to constitute the programme outcomes?

Is the curriculum formally approved by the HEI the programme belongs to?

Does the curriculum embed a student-centred learning and teaching approach that enables flexible learning paths and encourages students to take an active role in co-creating the learning process?

### 2.2 Assessment of students’ learning

**Documentation to be provided**

*Note: The methods and criteria of assessment of the students’ learning should be included in the characteristics of the course units/modules.*

**Questions to be considered**

Do the assessment methods and criteria provide evidence of their capacity to check the effective achievement of the intended course unit/module learning outcomes by the students and ensure trust that the level of achievement by the students is assessed in a credible way?

### 2.3 Planning of the learning process

**Documentation to be provided**

Calendar and timetable of didactic activities and examinations.

**Questions to be considered**

Has the development of the learning process been planned in order to enable students to achieve the programme outcomes in the expected time?

### 2.4 Management of the learning process

**Documentation to be provided**

Description of how the teaching and learning process and student assessment are managed including a feedback loop in relation to the quality of the learning process and the assessment of students. This should include statistical analysis and documentation used.

**Questions to be considered**

How does the management of the learning process assure achievement of the programme aims and the programme outcomes?

Do the results of the quality control of the assessment tests attest their adequacy and appropriateness?

Is the achievement of the learning outcomes of course units/modules adequately assessed?

### 3. Resources

#### 3.1 Teaching staff

**Documentation to be provided**

Curricula vitae of teaching staff.
Teaching support staff.
Recruitment policy in the selection of the teaching staff.
Opportunities offered to the teaching staff to improve their teaching skills and the use of new technologies.
### Questions to be considered
Are the teaching staff appointed according to pre-defined recruitment criteria?
Are the teaching staff quantitatively and qualitatively adequate for the achievement of the programme outcomes by students?
Are the teaching support staff qualitatively adequate for the achievement of the established programme outcomes by students?
Does the programme offer the teaching staff the opportunity to improve their teaching skills and the use of new technologies?

<table>
<thead>
<tr>
<th>3.2 Facilities and support staff</th>
<th>Documentation to be provided</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Classrooms used by the programme, with the equipment available.</td>
</tr>
<tr>
<td></td>
<td>Rooms for individual study used by the students of the programme, with the equipment available.</td>
</tr>
<tr>
<td></td>
<td>Laboratories/workshops used by the programme, with the equipment and technical staff available.</td>
</tr>
<tr>
<td></td>
<td>Libraries used by the students of the programme, with the equipment, services and library staff available.</td>
</tr>
<tr>
<td></td>
<td>Other resources and special initiatives.</td>
</tr>
</tbody>
</table>

### Questions to be considered
Are the facilities at the disposal of the programme, with the associated equipment, quantitatively and qualitatively adequate for the development of the established programme aims as designed and planned, and enable the application of the established didactic methods?
Is there adequate technical and library staff?

<table>
<thead>
<tr>
<th>3.3 Financial resources</th>
<th>Documentation to be provided</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Needs and availability of financial resources.</td>
</tr>
</tbody>
</table>

### Questions to be considered
Are the financial resources available to the programme adequate for the development of the learning process as designed and planned?

<table>
<thead>
<tr>
<th>3.4 Student support services</th>
<th>Documentation to be provided</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Organization, management and activities of student support (career advice, tutoring and assistance) services, and administrative staff available.</td>
</tr>
</tbody>
</table>

### Questions to be considered
Does the programme provide student support (career advice, tutoring and assistance) services relevant to the learning process and enable students’ learning and progression easier?
Is renewable energy the administrative staff quantitatively and qualitatively adequate for the effective management of the student support services?

<table>
<thead>
<tr>
<th>3.5 Partnerships</th>
<th>Documentation to be provided</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Partnerships which enable training periods outside the university.</td>
</tr>
<tr>
<td></td>
<td>Partnerships which enable international study mobility periods.</td>
</tr>
</tbody>
</table>

### Questions to be considered
Are the partnerships with public and/or private bodies for training periods outside the university adequate quantitatively and qualitatively to the achievement of the programme outcomes?
Are the partnerships with foreign universities or other HEI’s for international mobility adequate?
quantitatively and qualitatively to the achievement of the programme outcomes?

## 4. Student Admission, transfer, progression and graduation

<table>
<thead>
<tr>
<th>4.1 Rules governing the students’ academic career</th>
<th>Documentation to be provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qualifications and requirements for admission to the programme and methods of assessment of their possession by the students. Regulations for the recognition of higher education qualifications, periods of study and prior learning. Criteria for the management of the students’ progression in their studies. Certification of students’ studies successfully completed.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4.2 Entrance students</th>
<th>Documentation to be provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Results of the assessment of the possession of the admission requirements. Results of the examination performance in the first year.</td>
<td></td>
</tr>
</tbody>
</table>

### Questions to be considered

Do the results of the student examination performance in first year provide evidence of the programme attractiveness and the adequacy of the entrance requirements? Is the first year curriculum designed to motivate students towards studying engineering?

<table>
<thead>
<tr>
<th>4.3 Student assessment</th>
<th>Documentation to be provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Result of the assessment of the students’ learning in each module and each year.</td>
<td></td>
</tr>
</tbody>
</table>

### Questions to be considered

Do the results of the monitoring of the students’ achievement of the learning outcomes provide evidence of the effectiveness of the learning process in the course units/modules?

<table>
<thead>
<tr>
<th>4.4 Student progression</th>
<th>Documentation to be provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Results of the monitoring of student progression in the different course years. Results of the monitoring of dropouts. Results of the monitoring of the credits acquired by the students who pass from one course year to the next one. Results of the monitoring of the duration of studies leading to graduation.</td>
<td></td>
</tr>
</tbody>
</table>

### Questions to be considered

Do the results of the monitoring of students’ progression in their studies provide evidence of the effectiveness of the learning process?

<table>
<thead>
<tr>
<th>4.5 Student feedback on the learning process</th>
<th>Documentation to be provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students’ opinion on the quality of course units/modules. Students’ opinion on the training periods outside the university. Students’ opinion on the periods of</td>
<td></td>
</tr>
</tbody>
</table>

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Questions to be considered
Is the monitoring of student opinion adequate in relation to completeness of information gathered and response rate?
Do the results of the monitoring of student opinion on the learning process provide evidence of the adequacy and effectiveness of the learning process and of student support services?

4.6 Engineering graduates’ placement

Questions to be considered
Do the results of the monitoring of the engineering graduates’ job placement and of the employed graduates’ and employers’ opinions on the graduates’ education provide evidence of the qualification’s value, of the appropriateness of the programme aims and the programme outcomes to the educational needs of the labour market?

5. Internal Quality Assurance

5.1 Policy and processes for the quality assurance of programmes

Questions to be considered
Does the HEI conform to public policy for the quality assurance of programmes?
Has the HEI an effective management system and effective decision-making processes for the quality assurance of programmes?

5.2 Management system of the programme

Questions to be considered
Does the programme participate satisfactorily in the HEI quality assurance processes and implement relevant findings?

5.3 Programme review and development

Questions to be considered

Documentation to be provided
Policy for the quality assurance of programmes of the HEI.
Organizational structure for the quality assurance of programmes and decision-making processes of the HEI.

Documentation to be provided
Quality assurance policies and procedures relevant to the programme.

Documentation to be provided
Policies and procedures for programme review and development.
Results of most recent programmatic review.
### Questions to be considered
Does the programme periodically review needs and objectives, learning process, resources, results and management system, in order to guarantee their continuing relevance and effectiveness? Does it promote the improvement of the effectiveness of the processes of programme management and of the associated results?

### 5.4 Public availability of information

<table>
<thead>
<tr>
<th>Questions to be considered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the programme make publicly available full, up to date, easily accessed information, both quantitative and qualitative, on its objectives, learning process, resources, results and management system?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Documentation to be provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Documentation in relation to the quality assurance of the programme as publicly provided.</td>
</tr>
</tbody>
</table>
Appendix 4 – Comparison of Master Degree Requirements

<table>
<thead>
<tr>
<th></th>
<th>South Africa</th>
<th>Namibia</th>
<th>Europe/Germany</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level Descriptors</strong></td>
<td>NQF (total 10) Level 9</td>
<td>NQF (total 10) Level 9</td>
<td>EQF (total 8) Level 7</td>
</tr>
<tr>
<td><strong>Learning Objectives</strong></td>
<td>Outcome based / driven – Constructive Alignment approach</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Workload</strong></td>
<td>Notional hours 10 notional hrs = 1 credit</td>
<td>ECTS 25-30 hrs = 1 ECTS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>40 hrs / week 45 week full-time academic year 1800 hrs / year</td>
<td>40 hrs / week 45 week full-time academic year 1200 hrs /year</td>
<td></td>
</tr>
<tr>
<td><strong>Credits</strong></td>
<td>180 - 240 credits 120 at NQF Level 9 60 credits for the thesis</td>
<td>min 240 credits (total) all at NQF Level 9 ¼=60 credits for the thesis</td>
<td>60 - 120 ECTS 30 ECTS for the thesis</td>
</tr>
<tr>
<td></td>
<td>3 credits = 1 ECTS</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Standard Entry Requirements</strong></td>
<td>480 credits 4800 hrs four-year-degree (also possible: B.Tech. degree or a postgraduate diploma)</td>
<td>Bachelor or postgraduate diploma</td>
<td>180 ECTS - 240 ECTS 4500 hrs - 6000 hrs Bachelor degree / former Diploma aptitude</td>
</tr>
<tr>
<td><strong>Recognition of Prior Learning</strong></td>
<td>institutional decision (with regard on credits and learning outcomes)</td>
<td>since Lisbon Convention strengthened, reserved to HEI</td>
<td></td>
</tr>
<tr>
<td><strong>Master Thesis</strong></td>
<td>1/3 or ¼ (Prof. Master) research Master Master’s Degree by Dissertation Master’s Degree by Coursework and mini-dissertation</td>
<td>30-60 (30 credits is a mini thesis)</td>
<td>30 ECTS (1/3 if 3 semester master)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>180 credits / yr 1800 hrs</td>
<td>min 120 credits /yr. 1200 hrs</td>
<td>60 ECTS /yr 1500 hrs</td>
</tr>
</tbody>
</table>