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QUALITÄTSSICHERUNG DURCH
AKKREDITIERUNG VON
STUDIENGÄNGEN E.V.

FINAL REPORT

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND
TECHNOLOGY

KNUST ENGINEERING EDUCATION PRO- JECT (KEEP)

“POWER SYSTEMS ENGINEERING” (MPHIL)

“ELECTRICAL ENGINEERING” (PHD)

“RENEWABLE ENERGY TECHNOLOGIES” (MSC/MPHIL)

“SUSTAINABLE ENERGY TECHNOLOGIES” (PHD)

November 2023



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DECISION OF THE AQAS STANDING COMMISSION ON THE STUDY PROGRAMMES

- “POWER SYSTEMS ENGINEERING” (MPHIL)
- “ELECTRICAL ENGINEERING” (PHD)
- “RENEWABLE ENERGY TECHNOLOGIES” (MSC/MPHIL)
- “SUSTAINABLE ENERGY TECHNOLOGIES” (PHD)

OFFERED BY KWAME NKURUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY (GHANA)

Based on the report of the expert panel, the comments by the university and the discussions of the AQAS Standing Commission in its 18th meeting on 21 August 2023, and the circulation procedure of 18 October 2023 the AQAS Standing Commission decides:

1. The study programmes “Power Systems Engineering” (MPhil), “Electrical Engineering” (PhD), “Renewable Energy Technologies” (MSc/MPhil), and “Sustainable Energy Technologies” (PhD) offered by Kwame Nkrumah University of Science and Technology, Ghana are accredited according to the AQAS Criteria for Programme Accreditation (Bachelor/Master) and the AQAS Criteria for Doctoral Programme Accreditation (PhD).

The accreditations are conditional.

The study programmes essentially comply with the requirements defined by the criteria and thus the Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG) and the European Qualifications Framework (EQF) in their current version. The required adjustments can be implemented within a time period of twelve months.

2. The conditions have to be fulfilled. The fulfilment of the conditions has to be documented and reported to AQAS no later than **30 November 2024**. The confirmation of the conditions might include a physical site visit within the time period of twelve months.
3. The accreditation is given for the period of **six years** and is valid until **30 November 2029**.

Conditions:

For all programmes:

1. The course descriptions of all programmes have to be revised outlining the assessment method(s) of each course in detail.
2. A clear compilation of all regulations and policies which are relevant to the Master’s and PhD programmes offered by the ACE KEEP is required.

3. The ACE KEEP homepage, serving as the main source of information, needs to be updated regarding the following aspects:
 - a. publication of all relevant regulations and policies that apply to the programmes (either by linkage to the information on the Post-Graduate School's website or by adding these documents on its own website);
 - b. a transparent outlining of the current taught curricula of the programmes;
 - c. the outlining of current research lines for the programmes.

Additional conditions for “Power Systems Engineering” (MPhil) and “Electrical Engineering” (PhD):

4. The department has to find alternative ways to fill open positions to strengthen the number of teaching staff, e. g., by considering more external lecturers from the industry or from abroad. Therefore, a strategic plan has to be developed.
5. It has to be ensured that students have sufficient access to software licenses regularly needed for teaching, learning, and research, such as MATLAB, PSSE, and AutoCAD.
6. A renewal of the Power Lab is required to ensure students' exposure to up-to-date technologies relevant to the curriculum of the Master's and the PhD programme. Appropriate evidence on which new equipment was bought and how it is used in the programmes must be provided.

Additional conditions for “Electrical Engineering” (PhD) and “Sustainable Energy Technologies” (PhD):

7. The intended learning outcomes of the PhD programmes must be defined with a clear reflection of level 8 of the European Qualifications Framework.
8. Further practical equipment is required to enable up-to-date research, such as access to emerging technologies (e. g., irradiance sensors, IV-curve scanners, weather stations, demonstrators, or energy components for biomass energy, wind energy, and solar energy projects).

The following **recommendations** are given for further improvement of the programmes:

For all programmes:

1. A better coordination between the different lecturers and a more transparent system of available topics for the assignment of Master's thesis topics is required. The department should develop a respective concept.
2. Evaluation results should be directly discussed with the students of the course to close the PDCA cycle and to increase acceptance and ownership of the QA cycle.
3. The university, together with the faculties, should develop a set of rules for scientific publishing in advance of PhD theses. The university should provide the rough framework – e.g., that scientific publishing is desired in the context of a dissertation – which is then specified in more detail by faculties, e. g., number and type of publications. It is recommended to follow international practices of the different disciplines when defining the rules, so that potentially frequently occurring, large discrepancies between internal and external reviews of PhD theses are avoided and the PhD degree is internationally compatible.
4. A stronger integration of the private sector into the advisory processes of ACE KEEP is recommended to enhance the integration of industry projects and linkage with the industry.

5. The assessment regulations should allow for more flexibility in terms of ratio between continuous assessments and final assessment. Also, the regulations should allow for choosing the formats to follow the needs of the respective department.
6. Graduates of the programmes should receive an additional document (e. g., a diploma supplement) which serves as an explanatory document on the Ghanaian higher education system and the grading system, especially to foster internationalisation and mobility of students.
7. It is recommended to include personally assigned and permanent working places, preferably in the ACE KEEP building, for PhD students who are in their research phase.

Additional recommendation for “Power Systems Engineering” (MPhil) and “Electrical Engineering” (PhD):

8. The Department of Electrical Engineering should establish Memoranda of Understanding with higher education institutions in Africa with similar standing and expertise to establish initial steps of expertise exchange.

Additional recommendations for “Renewable Energy Technologies” (MSc/MPhil) and “Sustainable Energy Technologies” (PhD):

9. It is advised to implement courses on emerging technologies, such as solar fuels. These courses should also cover adjacent topics which are relevant of decentralized energy systems and hybrid systems, such as courses on energy storage technologies, smart energy management technologies, and electric mobility.
10. The reading lists of the courses should be updated, listing at least one additional recent publication, report or book.
11. The teaching staff’s possibilities to conduct research should be strengthened as long as the teaching load is as high as at the moment.
12. Considering recommendation No 3 and in order to better align the PhD programme with European standards of appropriate PhD theses (and to enhance the visibility of PhD research in the international research community), it is advised to publish research results that originate from the PhD programme in at least two manuscripts to be submitted to accredited scientific journals with an impact factor.

With regard to the reasons for this decision the Standing Commission refers to the attached experts’ report.

EXPERTS' REPORT**ON THE STUDY PROGRAMMES**

- “POWER SYSTEMS ENGINEERING” (MPHIL)
- “ELECTRICAL ENGINEERING” (PHD)
- “RENEWABLE ENERGY TECHNOLOGIES” (MSC/MPHIL)
- “SUSTAINABLE ENERGY TECHNOLOGIES” (PHD)

OFFERED BY KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY (GHANA)

Visit to the university: 24–27 April 2023

Panel of experts:

Prof. Dr. Axel Küpper	Technical University Berlin (Germany), Institute of Telecommunication Systems
Prof. Dr. Angèle Reinders	Eindhoven University of Technology (The Netherlands), Director of Solliance Solar Research
Prof. Dr. Kirsten Weide-Zaage	University of Hannover (Germany), Faculty of Electrical Engineering and Informatics
Dr. Norbert Völker	German Engineering Industry Association (VDMA e.V.), Head of International Education/Education Policy Officer, Frankfurt am Main (Germany) (representative of the labour market)
Daniel Irmer	PhD student at École des Mines Paris – PSL University (France) (student expert)

Coordinators:

Patrick Heinzer & Ninja Fischer	AQAS, Cologne, Germany
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I. Preamble

AQAS – Agency for Quality Assurance through Accreditation of Study Programmes – is an independent non-profit organisation supported by more than 90 universities, universities of applied sciences and academic associations. Since 2002, the agency has been recognised by the German Accreditation Council (GAC). It is, therefore, a notified body for the accreditation of higher education institutions and programmes in Germany.

AQAS is a full member of ENQA and also listed in the European Quality Assurance Register for Higher Education (EQAR) which confirms that our procedures comply with the Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG), on which all Bologna countries agreed as a basis for internal and external quality assurance.

AQAS is an institution founded by and working for higher education institutions and academic associations. The agency is devoted to quality assurance and quality development of academic studies and higher education institutions' teaching. In line with AQAS' mission statement, the official bodies in Germany and Europe (GAC and EQAR) approved that the activities of AQAS in accreditation are neither limited to specific academic disciplines or degrees nor a particular type of higher education institution.

II. Accreditation procedure

This report results from the external review of the Master's and PhD programmes "Power Systems Engineering" (MPhil), "Electrical Engineering" (PhD), "Renewable Energy Technologies" (MPhil/MSc), and "Sustainable Energy Technologies" (PhD) offered under the KNUST Engineering Education Project (KEEP) by Kwame Nkrumah University of Science and Technology (Ghana).

1. Criteria

Each programme is assessed against a set of criteria for accreditation developed by AQAS: the AQAS Criteria for Programme Accreditation (Bachelor/Master) and the AQAS Criteria for Doctoral Programme Accreditation (PhD), respectively. The criteria are based on the Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG) 2015. To facilitate the review each criterion features a set of indicators that can be used to demonstrate the fulfilment of the criteria. However, if single indicators are not fulfilled this does not automatically mean that a criterion is not met. The indicators need to be discussed in the context of each programme since not all indicators necessarily can be applied to every programme.

2. Approach and methodology

Initialisation

The university mandated AQAS to perform the accreditation procedure in March 2021. The university produced a Self-Evaluation Report (SER). In December 2021, the institution handed in a draft of the SER together with the relevant documentation on the programmes and an appendix and statistical data on the programmes. The appendix included e.g.:

- an overview over statistical data of the student body (e.g., number of applications, beginners, students, graduates, student dropouts),
- the CVs of the teaching staff/supervisors,
- information on student services,

- core information on the main library,
- as well as academic regulations.

AQAS checked the SER regarding completeness, comprehensibility, and transparency. The accreditation procedure was officially initialised by a decision of the AQAS Standing Commission on 21 February 2022. The final version of the SER was handed in November 2022.

Nomination of the expert panel

The composition of the panel of experts follows the stakeholder principle. Consequently, representatives from the respective disciplines, the labour market, and students are involved. Furthermore, AQAS follows the principles for the selection of experts defined by the European Consortium for Accreditation (ECA). The Standing Commission nominated the aforementioned expert panel in February 2023. AQAS informed the university about the members of the expert panel and the university did not raise any concerns against the composition of the panel.

Preparation of the site visit

Prior to the site visit, the experts reviewed the SER and submitted a short preliminary statement including open questions and potential needs for additional information. AQAS forwarded these preliminary statements to the university and to all panel members in order to increase transparency in the process and the upcoming discussions during the site visit.

Site visit

After a review of the SER, a site visit to the university took place on 24-27 April 2023. On site, the experts interviewed different stakeholders, e.g., the management of the higher education institution, the programme management, teaching and other staff, as well as students and graduates, in separate discussion rounds and consulted additional documentation as well as student work. The visit concluded by the presentation of the preliminary findings of the group of experts to the university's representatives.

Reporting

After the site visit had taken place, the expert group drafted the following report, assessing the fulfilment of the AQAS Criteria. The report included a recommendation to the AQAS Standing Commission. The report was sent to the university for comments.

Decision

The report, together with the comments of the university, forms the basis for the AQAS Standing Commission to take a decision regarding the accreditation of the programmes. Based on these two documents, the AQAS Standing Commission took its decision on the accreditation on 16 October 2023. AQAS forwarded the decision to the university. The university had the right to appeal against the decision or any of the imposed conditions.

In November 2023, AQAS published the report and the result of the accreditation as well as the names of the panel of experts.

III. General information on the university

The Kwame Nkrumah University of Science and Technology (KNUST) was established in 1951 as the Kumasi College of Technology. Ten years later, KNUST became a full-fledged university has been renamed to its current name. KNUST strives to provide an environment for research, entrepreneurship and teaching in science and technology for the industrial and socio-economic development of the country, the region and beyond. As of 2022, the university has 4,484 members (1,117 academic and 3,367 non-academic staff). At the same time, KNUST has 74,362 students (63,458 undergraduate and 10,877 graduate students).

KNUST's organisational structure is headed by the Chancellor, supported by the Vice-Chancellor. The university has six colleges (College of Agriculture and Natural Resources, College of Art and Built environment, College of Humanities and Social Sciences, College of Engineering, College of Health Sciences, and the College of Science). These colleges are subdivided into faculties, schools, and departments. Some of them have research centres.

The study programmes under review in this cluster are located at the College of Engineering. As of 2020/21, the college hosts 10,045 students (9,332 undergraduate and 713 postgraduate students). The college comprises three faculties (Faculty of Civil and Geo-Engineering, Faculty of Mechanical and Chemical Engineering, and the Faculty of Electrical and Computer Engineering), eleven teaching departments, and five centres. The college hosts the "The Brew Hammond Centre" (TBHEC), the "Technology Consultation Centre" (TCC), the "Regional Water and Environment Sanitation Centre Kumasi" (RWESCK), the "West Africa Science Service Centre for Climate Change and Adapted Land Use" (WASCAL), and the "Regional Transport Research and Education Centre Kumasi" (TRECK).

The programmes under review are administered under the KNUST Engineering Education Project (KEEP) and offer programmes allocated to the Department of Electrical Engineering ("Power Systems Engineering" (MPhil), and "Electrical Engineering" (PhD)), and the Department of Mechanical Engineering ("Renewable Energy Technologies" (MPhil/M.Sc.), "Sustainable Energy Technologies" (PhD)). It is outlined that the financial distribution (mainly by tuition fees) is as follows: Administration (10%), College (20%), Faculty (7%), College Library (3%), and Department (60%).

IV. Assessment of the study programmes

1. Quality of the curriculum / Aims and structure of the doctoral programme

Bachelor's/Master's degree

The intended learning outcomes of the programme are defined and available in published form. They reflect both academic and labour-market requirements and are up-to-date with relation to the relevant field. The design of the programme supports achievement of the intended learning outcomes.

The academic level of graduates corresponds to the requirements of the appropriate level of the European Qualifications Framework.

The curriculum's design is readily available and transparently formulated.

[ESG 1.2]

Doctoral degree

The intended learning outcomes of the programme are defined and available in published form. They reflect both academic and labour-market requirements and are up-to-date with relation to the relevant field. The design of the programme supports the achievement of the intended learning outcomes.

The academic level of graduates corresponds to with the requirements of the appropriate level of the national qualifications framework or the European Qualifications Framework.

The curriculum's design is readily available and transparently formulated.

[ESG 1.2]

a) Department of Electrical Engineering

Power Systems Engineering (MPhil)

Description

According to the SER, the intended learning outcomes (ILO) at programme level for the Master's programme "Power Systems Engineering" are designed to enable graduates with solid career prospects in electrical engineering. It is outlined that the ILOs on programme level cover equipping students with knowledge and skills to plan, design, and operate modern electric power systems, imparting skills to carry out research in electric power systems, and enabling students to develop new techniques and tools for improved power system operations. It is said that the programme is a combination of teaching, research, and collaborations with the industry.

In total, the curriculum consists of 59 credit points (CP) according to the local credit system. It is outlined that the courses consist of theoretical and practical components. The self-evaluation report indicates that the first semester includes mandatory courses, covering topics such as "Power system components", "Energy systems and analysis", "Computational concepts and tools", "Project management and investment appraisal", and "Protection of power systems". The second semester includes four mandatory courses and two elective courses. While the mandatory courses focus on "Electrical installations", "Smart grids and energy management systems", "Power electronics", and "Engineering research methods", the elective courses offer a choice of "Control concepts and methods", "New and renewable energy systems", or "Power markets and economics". The second year includes two seminars and thesis writing.

According to the SER, graduates of this programme can be employed in the power, oil and gas, mining, or manufacturing industry, in teaching and research institutions, or they can be self-employed.

Experts' evaluation

The given name of the programme is "MPhil in Power Systems Engineering" on which the accreditation shall be given. This is in contradiction to the name given on the website which is "Power and Energy Systems

Engineering”, and which must thus be corrected on the internet (**finding 1**). The experts point out that this evaluation only covers the programme as listed above (and respectively, its accreditation if it is to be gained); if there are other programmes at the centre or faculty with similar names, they would need a separate evaluation and accreditation, if needed.

Concerning the desired qualifications in terms of the intended learning outcomes, the focus of the programme is on power systems operations and control. This comes with the possibility of a programme that is focused on delivering a high level of skills for the industry, or as a preparation for a following PhD and job perspectives in academia. The programme aims to train mid-career professionals with a science background specialised in engineering. The MPhil programme reflects the power systems bias of the department, like smart grids and the planning, design and operation of modern electric power systems. The intended learning outcomes as well as the learner’s progression are supported by the modular structure with the practise phase before the Master’s thesis. The learning outcomes are adequately formulated for both targets of the programme: educating students for a career in the industry and qualifying them for a PhD.

Since the MPhil is mandatory for the PhD, the programme is highly research oriented. Thus, students who already work in the industry (or who have gained work experience in the industry for a longer period after their Bachelor’s) struggle with the high amount of research and would wish this would be adapted. This should be considered in the future, e. g. by also creating a M.Sc. programme like in other departments in which the focus lies more on practical-oriented training.

According to the double focus of the programme (employability as well as research orientation), the learning outcomes adequately reflect both academic/scientific as well as labour market requirements, which can be regularly updated thanks to a close collaboration with the industry and research inputs by the centre’s members. It is noteworthy that there is no competitor at national level for the programme which gives the Master’s (and the PhD) a monopoly position. Because of this, the focus in the programme’s development should be on maintaining this level.

Interdisciplinary elements are included in the programme in terms of project management and computational concepts. Furthermore, for interdisciplinarity and other skills, courses from the whole university can be chosen in the elective parts of the curriculum. This is adequate and ensures that the students can acquire skills and competences in this area during their studies. Three different laboratories (AI, Dipper, and IOT) are provided for the students, and the learning in the programme is project-based. The covering of subject-specific and cross-subject knowledge as well as subject-related, methodological, and general skills is done by excursions and the integration of specific problems or topics from the industry in courses. This leads to an adequate concept of the programme concerning its learning outcomes which can be achieved.

The achievement of the learning outcomes upon completion of the programme is demonstrated by a final obligatory Master’s thesis for which students have half a year to conduct it. Additionally, the programme requires a six-months-long practical phase with an individual assignment in the student’s field of studies and work to solve a defined problem. The students can suggest topics of their own interest or topics are extracted from research or industrial projects to choose from. At concept level, this is adequate to reflect the research- as well as the more practical-oriented aspects of the curriculum. It also ensures that the Master’s level is comparable to level 7 of the European Qualifications Framework. Thesis examples were available for review during the site visit and were acceptable considering form and content. However, a better coordination of the work’s assignment is necessary, since the students the experts were able to talk to had difficulties in finding an adequate topic. A better coordination between the different lecturers and a more transparent system of available topics is required. Thus, the experts recommend developing a respective concept (**finding 2**).

At curriculum level, the actual number of practical courses/parts of each course depends on the lecturer; there is no specific ratio of practical parts a course has to fulfil. This can also be improved in the future by agreeing on uniform standards.

In the curriculum, the total programme workload is correctly and transparently allocated to the different courses, and the credit points are also assigned correctly to the individual courses, regarding the local credit system. Furthermore, a typical course plan is available. The course descriptions are complete including information on each courses' function in the curriculum about their compulsory or elective character. But the course descriptions for all Master's programmes under review have to be updated outlining the assessment methods of the courses which until now are not given. The assessment methods are an essential information for students to plan the semester accordingly as they will know in advance which assessments they have to plan for **(finding 3)**.

Evaluation of the courses is provided but the results should be directly discussed with the students of the course to ensure an improvement and thus close the feedback loop **(finding 4)**. In terms of the labour market feedback, this is done by the collaboration with industrial partners.

Conclusion

The criterion is partially fulfilled.

Electrical Engineering (PhD)

Description

According to the SER, the department has designed the PhD programme based on intended learning outcomes related to electric power engineering topics and subtopics. The programme strives to enable students to evaluate the application of different methods in subject-specific areas, to carry out research activities, conduct research at a high international level, address complex technical questions and challenge established knowledge, evaluate the work of others, participate in complex multidisciplinary assignments and projects, participate in international science-driven debates, assess the need to and drive innovation, and acquire new knowledge in the field.

The curriculum of the programme consists of 109 CP, according to the local credit system, within six semesters. While the first year is to equip PhD students with essential research skills, the final two years shall focus on individual research topics. The first year includes mandatory and elective courses (in case the PhD includes course work which is, for example, mandatory if the Master's degree was not gained in the department). It is indicated that all courses include theoretical and practical components. The first semester includes five mandatory courses, covering topics such as "Power system components", "Energy systems and analysis", "Computational concepts and tools", "Project management and investment appraisal", and "Protection of power systems". The second semester comprises four mandatory courses and two elective courses. While the mandatory courses focus on "Electrical installations", "Smart grids and energy management systems", "Power electronics", and "Engineering research methods", the elective courses offer a choice of "Control concepts and methods", "New and renewable energy systems", or "Power markets and economics". Students have to take a research seminar each semester and continue the thesis writing process from the second year until the fourth year.

The graduates' profile indicates that graduates of this programme can be employed in electric utility companies, self-employment or engage with teaching research institutions.

Experts' evaluation

Concerning the desired qualifications in terms of the learning outcomes, the focus of the programme lies on the doctoral level education specialized in power systems operations and control. This comes with the possibility of a reaching a high level of skills necessary for working in the industry. The programme aims to train mid-career professionals with a science background specialized in engineering. The learning outcomes reflect both academic/scientific as well as the labour market requirements with a regular update in collaboration with the industry and inputs from research. As already noted for the MPhil programme, the PhD holds a monopoly position within Ghana as well. The MPhil "Power Systems Engineering" and the PhD programme are stated to be consecutive programmes. However, the intended learning outcomes of the PhD programme are too similarly formulated to the level of the Master's programme. Therefore, the intended learning outcomes at PhD programme level must be defined with a clear reference to level 8 of the European Qualifications Framework (**finding 5**). However, the experts are convinced after the site visit that the programme meets the standards of level 8 of the EQF and that this is not a general problem of the programme itself, but a documentation issue that can easily be solved.

If the courses offered have already been passed in the MPhil programme, they do not have to be taken again in the PhD phase. For students coming from other disciplines or universities, the courses have to be taken and passed. The programme, however, lasts for three years, also when skipping the courses' part. If students bring a transcript of records showing that they have done comparable courses, they can be recognised on an individual level.

Interdisciplinary elements are included in the same way as in the Master's programme when it comes to the courses offered. Furthermore, conducting their own research leads to project management and communication skills. Additionally, students of this programme can also take interdisciplinarity and other skills courses from the whole university in the elective parts of the curriculum or as extra-curricular activities. To achieve further soft skills, courses on presentation skills, etc. are provided for all post graduate students at the Post-Graduate School. Furthermore, PhD students have the possibility to work as tutors for undergraduate and post-graduate students, limited by the funding possibilities. Nevertheless, some students also apply for the opportunity to teach without funding to gain experience, especially those who see their future career in academia.

Supervisors are assigned to the students to support them in their progression. They meet every week to make sure that problems can be discovered early. This is suitable to ensure the academic and research progress but also to enhance communication skills. The Post-Graduate School requires a progression report on each student to be sent regularly to the board. Orientation and guidance during the PhD are ensured by these means.

For the thesis, there is an internal committee/board to check and accept PhD dissertation research proposals by students which can be developed together with the supervisor. The supervisors are assigned at the beginning of the programme. The committee is set up with five members: the supervisor from KNUST (professor), two additional professors of KNUST from different areas/disciplines, and two examiners who have to be from outside KNUST (with a minimum level of senior lecturer).

After the first year, the students have to present their current results of research (comparable to a mid-examination on progress) to be given the approval to continue with the research project. As the experts learned during the site visit, for PhD students in the Department of Electrical Engineering, two publications in international journals as author are needed to achieve the PhD. The publications have to fulfil the criteria given in the KNUST guidance handbook on publication. This is adequate for reaching an international comparable level.

The PhD students also have the chance, if funding is available, to attend conferences. The department has international collaborations with other universities which opens the possibility for internationalisation (for students and teaching staff). Due to the collaboration with industrial partners, the students have the possibility to

transfer their knowledge to situations outside the university context. When the thesis is finalized, an oral presentation of the work is mandatory. Overall, this concept shows that in its implementation level 8 of the European Qualifications Framework is reached.

When it comes to the allocation of workload to courses and course descriptions, the same assessment as for the Master's applies to the PhD programme, including the finding mentioned above (see Master's programme) (**finding 3**). The same applies to the feedback of evaluations results to the students (also see above) (**finding 4**).

Conclusion

The criterion is partially fulfilled.

b) Department of Mechanical Engineering

Renewable Energy Technologies (MSc/MPhil)

Description

The Master's programme "Renewable Energy Technologies" is offered in two different versions which either lead to the "Master of Science" (MSc) degree or the "Master of Philosophy" (MPhil) degree and which comprise of a one-year or two-years programme. The MPhil is stated to be more focused on training students to do a PhD after their Master's.

The intended learning outcomes of the MSc degree programme include the ability to assess different energy alternatives, conduct the technical and economic assessment of energy alternatives, including policymaking, problem-solving skills to address problems in the energy industry, and practical communication skills in different working environments.

The MPhil degree programme's ILOs include the intention to impart a more robust theoretical foundation to lead to the following core competencies: the ability to conduct research with sound methodological foundations, the assessment of energy alternatives, the conduct of the technical and economic assessment of energy alternatives, including policymaking, problem-solving skills to address problems in the energy industry, solving of real-life energy problems, and the ability to write technical reports.

The MSc degree programme "Renewable Energy Technologies" is a one-year programme with four mandatory courses and two elective courses per semester by which students gain 36 CP (according to the local credit system). The mandatory courses cover topics on "GIS for sustainable energy applications", "Research methods", "Energy policy, gender and planning", "Energy and environment" (for the first semester), and "Entrepreneurship and small business management", "Project analysis and management", and "Renewable energy laboratory" (for the second semester). As elective courses, students can choose between topics in "Liquid biofuel production systems", "Biogas technology", "Solar thermal technology", or "Small hydropower technology" in the first semester, and "Solar PV technology", "Wind power technology", "Bio-energy technology" or "Hybrid energy systems" in the second semester. The study programme ends with a research project. It is indicated that all courses include a mix of theoretical and practical content. The teaching methods are stated to include face-to-face teaching and online lectures, laboratory exercises, written exams, and research.

Structure-wise, the curriculum of the MPhil degree programme includes identical courses as the MSc degree programme in the first year. According to the SER, the MPhil programme's modus operandi is based on two semesters of online teaching and research, and one month of a residential session at KNUST to write the exams and undertake laboratory exercises. As it covers two years in which 57 CP are gained (according to the local credit system), in the second year, students take two courses each semester on their research project.

It is stated that graduates of the programme of each structure can be employed in ministries, electric companies (e. g., Volta River Authority or Aboadze Thermal Power), regulatory institutions, grid management companies, or similar renewable energy companies in Ghana or the region.

Experts' evaluation

Both versions of the Master's degree programme have been reviewed and it is concluded that the desired qualifications can be achieved by the curriculum according to the intended learning outcomes (ILOs) of both varieties. This is reflected by clearly described course objectives and feasible learning outcomes of all mandatory and elective courses, and also adequate ILOs at programme level.

The programme offers an interdisciplinary mandatory course package with the courses mentioned in the descriptive part above. The combination of these courses offers both methodological and cross-disciplinary topics. It forms a good basis for future employment in the industry as well as in academia and governmental bodies. Graduates of the programmes were able to find employment in these areas which gives evidence that the ILOs are achieved.

Subject-specific elements of the programme in both versions are offered as elective courses which are also listed above. This combination of elective courses reflects the specific renewable energy situation in Ghana, as well as other countries in West Africa, and supports the development of students in their preferred energy specialism(s). It is noticed that the courses about energy technology are hence adapted to their geographic application area and decentralized renewable energy systems. However, it is advised to consider developing courses for emerging technologies, like, e.g., solar fuels, and for adjacent topics which are relevant of decentralized energy systems and hybrid systems, such as courses on energy storage technologies, smart energy management technologies and electric mobility, in the future (**finding 6**).

All curricular elements are well documented. The course plan is well communicated by the provided documentation as well as by the study coordinators. Moreover, the total programme workload and each course's workload are correctly and transparently allocated, including the number of study credits according to the local credit system which are also correctly assigned to all elements of the curriculum. However, the assessment methods are not shown in the course descriptions. Therefore, the course descriptions have to be updated outlining the assessment methods of the courses, as already mentioned above for the programmes of the Department of Electrical Engineering (**finding 3**).

The learning outcomes of each course have a theoretical component (reflected by the knowledge obtained in the course), also called scientific learning outcomes, and a labour market-related learning outcome (reflected by the capabilities developed in the course to apply knowledge obtained in engineering, designs or real-life problem solving). By the clearly structured curriculum, the intended learning outcomes of the programme in each version are feasible and can be achieved within the expected timelines.

All learning outcomes are up to date and hence valid for the present situation. However, it is noticed that course materials offered by the reading lists of each course, though well selected, seem to be published before 2016. It is therefore advised to update the reading lists of the courses with one additional recent publication, report or book (**finding 7**).

The representatives of the labour market with whom the experts talked during the site visit indicated that they are satisfied with the motivation, skills, and knowledge of the students that have finished the programme at Master's level. It was positively mentioned by the representatives of the labour market that graduates of KNUST are better equipped with knowledge and understanding in the area of engineering as graduates of other universities in Ghana.

Written evaluation results of each course or the complete programme have not been disclosed. However, the experts' discussion with the students revealed a high level of confidence in the appropriateness of the study programme for either entering the job market or pursuing an academic career. Students mentioned that they conduct course evaluations on a regular basis and that the results are discussed with the lecturers involved. This shows that a robust and integrated quality assessment system exists. However, for transparency reasons it is advised to share (student) evaluation results of courses with them, e. g. in the university's intranet (**finding 4**).

Courses are offered in a hybrid mode, both online and in class, and communicated through a web-based information system. This enables students to attend lectures under all circumstances. The usage of different teaching and learning methods is adequate.

The academic degrees of MSc and MPhil correspond to the respective learning outcomes which adequately reflect the requirements of level 7 of the European Qualifications Framework. However, the Ghanaese academic system itself does not have a national qualifications framework. Both programmes are completed by a final thesis project with a written dissertation and an exam which is executed by a committee. This concept is adequate.

Conclusion

The criterion is partially fulfilled.

Sustainable Energy Technologies (PhD)

Description

The PhD programme "Sustainable Energy Technologies" covers eight semesters, including face-to-face and online lectures, laboratory exercises, written exams, and research in the first two semesters. As described in the SER, the curriculum is based on the following intended learning outcomes (ILOs): the ability to solve complex problems in the discipline; the analysis, synthesis and evaluation of interdisciplinary knowledge to solve complex problems in sustainable energy; the utilisation of entrepreneurial skills to convert ideas into business models; intercultural competencies; the ability to assess environmental, social and economic impacts; the ability to design, conduct, analyse and interpret data and experiments; the application of thermal sciences fundamentals; the application of basic principles of renewable energy converters, system design; the ability to maintain professional and ethical responsibility; the use of techniques, skills, and modern engineering tools; multi-disciplinary competencies; and problem-solving abilities in the area of engineering.

The first semester consists of four mandatory courses, including topics on "GIS for sustainable energy applications", "Research methods", "Energy policy, gender and planning", and "Energy and environment". The second semester includes two mandatory courses and two elective courses, including "Entrepreneurship and small business management", and "Project analysis and management" as mandatory courses, and "SPOLAR PV Technology", "Wind power technology", "Bio-energy technology", and "Hybrid energy systems" as electives. Years two to four consist of seminars, thesis writing, and supervised teaching.

The graduates of the programme shall be enabled to take positions at power generation companies, governmental ministries, regulatory institutions, grid management companies, renewable energy companies, energy production and power generation companies (R&D sector), consultancies in the discipline, or academia.

With graduation, the students have gained 115 CP according to the local credit system.

Experts' evaluation

The PhD programme is strongly aligned with the MSc/MPhil programme under review. Namely, the courses in the first two semesters are identical for PhD, MSc and MPhil students, if PhD students need to take these

courses (depending on their former education). After the coursework period or when the courses do not have to be taken (e. g., this is the case for MPhil graduates of KNUST), the PhD programme continues with an individual three-year research project. As such, the experts' evaluation of the first year of the PhD programme is identical with the evaluation in the previous chapter.

The desired qualifications of the PhD programme are well represented by the intended learning outcomes stated in the descriptive part above that include adequate subject-specific, scientific and interdisciplinary elements. These learning outcomes are well embedded in an academic setting and in the current developments of the labour market in Ghana and West Africa. The programme is completed by a thesis under supervision of a professor and several senior staff members that have obtained their doctor's title in the past. The thesis has to fulfil adequate standards according to clearly documented doctorate regulations for supervision which include intermediate evaluations of the PhD students as well as the completion of the PhD manuscript, its formal approval by a broad committee of experts and its defence. These regulations also cover procedures for the preparation and approval of research plans by PhD students, the establishment of a supervisory team and key moments for intermediate assessments of the progress of a PhD student. These regulations and procedures lead to a level which is fully comparable to the European higher education system. Accordingly, the intended learning outcomes of the programme are fully compatible with level 8 of the European framework.

However, in order to better align a PhD degree from KNUST with European conventions of appropriate PhD theses, it is advised to publish research results that originate from the PhD programme (**finding 8**). According to the regulations of KNUST at hand and the discussions on site how they are handled in the Department of Mechanical Engineering, at least two manuscripts must be submitted to accredited scientific journals (of which the impact factor is administrated by Thomson Reuters) but they do not need to be published. Compared to the requirements of other universities, this demand seems too low. Therefore, it is advisable to clearly regulate and make it thus transparent that scientific publishing is desired in the context of a PhD dissertation (**finding 9**). This advice is not compulsory for two important reasons. Namely, (1) excellent monographs of sufficient length and innovative content are also widely accepted as an appropriate thesis. And (2) costs of open access publishing can be a serious constraint, given the fact that they range from 2.000 to 4.000 Euros per publication, while to the experts' understanding, KNUST does not have free open access publication arrangements with internationally operating publishers such as Elsevier, Springer, and Wiley & Sons.

It was found out that a PhD title is required to enter the Ghanese job market of university lecturers. Given the high number of lecturers at KNUST with a doctor's title, apparently this requirement properly functions in practice. Besides, graduates of the PhD programme can also enter the job market in positions as mentioned above for the Master's programme. According to the discussions during the site visit, this is also possible for graduates of the programme.

Conclusion

The criterion is fulfilled.

2. Procedures for quality assurance

Bachelor's/Master's degree

The programme is subject to the higher education institution's policy and associated procedures for quality assurance, including procedures for the design, approval, monitoring, and revision of the programmes.

A quality-oriented culture, focusing on continuous quality enhancement, is in place. This includes regular feedback mechanisms involving both internal and external stakeholders.

The strategy, policies, and procedures have a formal status and are made available in published form to all those concerned. They also include roles for students and other stakeholders.

Data is collected from relevant sources and stakeholders, analysed, and used for the effective management and continuous enhancement of the programme.

[ESG 1.1, 1.7 & 1.9]

Doctoral degree

The programme is subject to the higher education institution's policy and associated procedures for quality assurance, including procedures for the design, approval, monitoring, and revision of the programmes.

A quality-oriented culture, focusing on continuous quality enhancement, is in place. This includes regular feedback mechanisms involving both internal and external stakeholders.

The strategy, policies, and procedures have a formal status and are made available in published form to all those concerned. They also include roles for students and other stakeholders.

Data is collected from relevant sources and stakeholders, analysed, and used for the effective management and continuous enhancement of the programme.

[ESG 1.1, 1.7 & 1.9]

Description

KNUST describes in its SER that it has a centralised unit (called Quality Assurance and Planning Unit; QAPU) and a decentralised quality assurance unit at department level. The overall aim of the QA units is to support training programmes for capacity enhancement, the improvement of the teaching and learning environment, mode of delivery of the courses, teaching and research material, student-lecturer relations, and the assessment of the quality of the teaching staff.

QAPU's role is to monitor and translate university-wide policies into practice. According to the documentation, these policies include quality assurance but also research, ethics, distance education, teaching, HIV/AIDS, intellectual property, procurement, disabilities, health and safety protection, maintenance, or open source.

The quality assurance system includes the monitoring of the evaluation processes of the programmes. The instruments comprise curriculum reviews (every four years), involving a departmental board and industry representatives, and the assessment of courses by students. Students must evaluate the courses every semester through an online assessment. The focus of the evaluation includes the lecturer's quality and the study environment. The unit also collects data on teaching loads, student's pass rates and failure rates.

The programmes of KNUST must undergo national accreditation procedures every four years. Within these processes, external stakeholders need to be involved through evaluations and dialogues. The process aims to review the curricula and teaching materials and to result in general improvements in the course structure. By annual reports on research activities, the external stakeholders shall be informed about the results.

Experts' evaluation

During the site visit, the panel could confirm that the different policies are enacted by the three departments which offer the programmes under review. Several boards and committees are installed for different procedures, such as the development of the curricula or the appointment of senior lecturers. The department

members are aware of the processes at the university and could assure the panel that all regulations are followed. Further improvements, especially of the documentation, e. g., of course descriptions, have already been initialised by the university. However, to ensure transparent and accessible information not only for external members but also for the students or new faculty members, a compilation of all relevant regulations and policies for each study programme is necessary (**finding 10**). At the moment, there are several different documents covering different but important information on different aspects of studying at KNUST (including aspects of good scientific practice and safeguarding against intolerance and discrimination) at the departments under review. This is quite confusing and needs to be merged into a comprehensive collection of information. Ideally, the information should be accessible, e. g., on the website of the department or alike that is updated on a regular basis – also see the experts' evaluation in chapter 7.

The consultation of labour market representatives that is supposed to take place on a regular basis seems to occur rather occasionally and not necessarily continuously, despite the fact that the departments themselves formulated the goal to increase cooperation with the private sector, and also besides the need to prepare for national accreditation every four years by including feedback from the labour market. Therefore, a stronger integration of labour market representatives in different boards and committees (e. g., for curricula development or in the department boards) is recommended, to allow the institution to enforce its liaisons with the private sector (**finding 11**).

At the moment, the programmes have a rather small number of students, and thus feedback of the students can be communicated directly or via the course speakers. Based on the discussions during the site visit, the panel of experts is convinced that feedback from the students is incorporated in the development of the programmes. Student involvement is also guaranteed at department and graduate school level via the association of graduate students. However, the departments should redesign the process of providing official feedback to the students after the evaluation of the courses, as apparently formal feedback is not always provided, as it was already explained above (**cf. finding 4**). Furthermore, an exit survey and a stronger follow-up on the student life cycle covering the whole programme could help the department to identify development potentials, especially with potentially rising number of students in some of the programmes.

An important step in the quality assurance of the programmes is the national accreditation which seems to have a positive impact on the programmes' development. Prior to this accreditation, a revision of the curricula is performed, taking into account the perspectives of external stakeholders, such as representatives of the labour market. Additionally, an alumni database was established and subsequently alumni surveys are conducted. The panel of experts encourages the departments strongly to keep following this path. It can be underlined that also in regard to the quality assurance of the programme, the planned revision of the curriculum is welcome and equally necessary in order to be able to achieve international accreditation in the future. From the experts' point of view, this procedure can only be brought to a good conclusion after a fundamental revision, as already explained in chapter 1.3.

Positively, the Master's and PhD programmes under review are all governed by the KNUST Post-Graduate School. Guidelines and an explanatory handbook covering all aspects of writing a Master's thesis and the structure and regulations for PhD programmes exist. The regulations are clear and provide a good structure for the students and departments. However, during the site visit, the experts became aware of the fact that the regulations of the Post-Graduate School are currently being reviewed by a committee. Apart from these centralized regulations, the departments might want to establish their own regulations for precision of study field related requirements and find an appropriate way of communicating them transparently within the department. This is supported by the experts since some departments might have needs for specific regulations and information of students which have a different or no significance for others.

The selection of PhD topics is, depending on the department, a mainly dialogue driven process between the potential PhD candidates and the supervisors. After writing a proposal, the department reviews the proposals internally, before the students defend them in front of a board on Post-Graduate School level. The approval of the board is compulsory for the inscription in the PhD programme. The availability of sufficient resources and supervision capacity and competence are checked during this process. Over the course of the PhD, the advancement is checked within the departments, and biannually reported to the graduate school via an online platform. Processes exist to mediate between supervisors and PhD students in case of problems, to add or replace supervisors and to extend the project duration. Within the supervision team, the PhD students' quality of research work is checked and approved before a commission for the defence of the PhD thesis is compiled. This commission consists of at least five people, including the supervisors, an independent internal staff member, and two external members of professorial grade. This is adequate in general, but the panel suggests that a participation of more external members could be considered to enhance the recognition of the PhD programmes.

Overall, despite some minor shortcomings as explained above, the experts are impressed by the dedication of the departments' staff towards their own quality standards and acknowledge a strong engagement to quality assurance and development.

Conclusion

The criterion is fulfilled.

3. Learning, teaching and assessment of students / Learning and assessment of students

Bachelor's/Master's degree

The delivery of material encourages students to take an active role in the learning process.

Students are assessed using accessible criteria, regulations, and procedures, which are made readily available to all participants and which are applied consistently.

Assessment procedures are designed to measure the achievement of the intended learning outcomes.

[ESG 1.3]

Doctoral degree

The form of supervision and/or course structure is adequate and corresponds with the intended learning outcomes.

Students are assessed using accessible criteria, regulations, and procedures, which are made readily available to all participants and which are applied consistently.

Assessment procedures are designed to measure the achievement of the intended learning outcomes.

[ESG 1.3]

Description

The SER outlines that typical teaching modes include PowerPoint presentations, lectures and seminars. It is explained that students shall take an active role in their learning process via guided reading, design exercises, laboratory sessions, individual or group assignments, community studies, master plans or field trips. Extra teaching or special assignments can be given to advanced students, if needed. Students are provided with examples of past examinations which shall help them reflect the examination types used.

It is explained that the PhD programmes use more case studies and practical evaluations, analysis of options and presentations compared to the Master's programmes.

The general setting of some programmes is designed in a block course system, while others run the regular semester system at KNUST. While the block course system includes final examinations at the end of the course block, the final examinations of courses in the latter happen at the end of the semester.

The examination regulations are included in the student's handbook and cover examinations and dissertations. In general, the examinations shall follow the regulations within KNUST's system. The guidelines on this are provided to students or published on notice's boards. The examination dates are set and marked on timetables. This information is made known to students at the beginning of the courses. If students have to repeat an exam, this can happen with the next batch or by supplementary examinations.

Experts' evaluation

To provide a holistic and student-centred learning approach, and for the achievement of competencies that follow the given learning outcomes, a change in the teaching and examination practice has taken place from pure imparting and testing of acquired knowledge at the end of a semester to the point of student-centred forms of learning, study-related services, and flexible module examinations. These forms are used according to the current stage of learning and of the acquisition of skills and competencies so they can be checked accordingly. Thus, in general, the learning and teaching methods in the programmes correspond to the intended learning outcomes adequately for all programmes under review.

To maintain and continuously improve the quality of teaching and learning methods, it needs to be taken into account that the professors and teaching staff need to be continuously trained to do so and to understand the learning process and progress of their students. They need to be able to create a learning environment that fulfils these preconditions for each student. In the same way, the teaching and learning material must allow opportunities that can be used to adapt the way of teaching to each student. Therefore, the experts encourage the departments to install regular feedback sessions with all teaching staff to foster steady overhauling of the teaching methods and material, and thus to raise the quality in an ongoing and steady process.

The teaching staff should be able to catch up with the current learning situation of each student. This cannot be done by examinations only; it needs to be a process without pressure to the students. This means that continuous support and guidance is necessary, so that teaching methods can be adjusted during the course and also the students can adjust their learning activities. Until now, since the number of students in the programmes under review is quite low and the teaching staff very dedicated, this support and feedback can be done on a personal basis easily. However, if the number of students rises, it should be kept in mind that this should be generally ensured. This will help to give feedback to students about their current stage of accomplishing the tasks but will also give an opportunity to regularly check and, if needed, change current learning activities. In the end, this practice will be beneficial and allow a bigger group of students to graduate without lowering the exposure and quality of the skills set.

For all programmes under review, the experts found the assessment regulations quite strict. Therefore, it is recommended to change them so they can allow for more flexibility in terms of ratio between continuous assessments and the final assessment, and in terms of the formats to follow the needs of each department which might vary according to the intended learning outcomes of each programme and course (**finding 12**). Besides that, looking at regulations for disabled students, etc., these are made clear in the student handbook and other documents covering regulations of KNUST and/or the departments (which need to be merged, also see the evaluation in the previous chapters of this report, **cf. finding 10**).

As already evaluated in chapter 2, the processes to guarantee the quality of the PhD programmes are adequate. However, one of the most important criteria for PhD students is publication work, as it was already discussed in chapter 1 in the respective sub-chapters for the PhD programmes under review. As mentioned there, students need to get feedback on the quality of their publications which can be assessed by papers

being published or at least accepted by journals with an impact factor; please see the chapters mentioned for further information (cf. findings 8, 11 & 12).

Conclusion

The criterion is fulfilled.

4. Student admission, progression, recognition and certification / Legal status, admission and certification

Bachelor's/Master's degree

Consistently applied, pre-defined, and published regulations are in place which cover student admission, progression, recognition, and certification.

[ESG 1.4]

Doctoral degree

The institution is entitled to award a doctorate.

Consistently applied, pre-defined, and published regulations are in place which cover student admission, progression, recognition, and certification.

[ESG 1.4]

Description

Admission

Department of Electrical Engineering

Power Systems Engineering (MPhil)

Following the statements in the KEEP handbook, BS. or BEng degree holders with a background in Electrical and Electronic Engineering from a recognised university with a minimum average grade of 2nd class lower division (2.5–2.8 according to the German grading system) can enrol in the programme. Applicants from a closely related discipline, e. g., Electronics or Physics, can also be considered.

Electrical Engineering (PhD)

The KEEP handbook outlines that graduates with an MSc, Meng, or MPhil degree in Electrical and Electronic Engineering from recognised universities can enrol in the programme. Applicants with degrees from closely related disciplines, e. g., Electronics or Physics can also be considered.

Department of Mechanical Engineering

Renewable Energy Technologies (MSc/MPhil)

Applicants with a BSc degree in Engineering or a related degree in Physics, Chemistry, Mathematics or Environmental Science with at least two years of working experience in the renewable energy industry are eligible for the programme. In addition, candidates with second class lower division degrees must pass an interview.

Sustainable Energy Technologies (PhD)

Besides an MPhil or MSc degree in Engineering or a related field, students must pass an interview.

Progression (general aspects)

In terms of students' progress, each programme's secretariat, in collaboration with the departments, keeps a record of students' exams, internship reports, and thesis progress reports. Additionally, the University Quality Assurance and Planning Unit collects information on students through the ARMIS software. The software is used to capture the profile of students, success, and failure rates.

Recognition (general aspects)

As explained in the SER, there is no policy on postgraduate students' recognition and credit transfer in the programmes. However, it is said that case-by-case decisions can be made.

Certification (general aspects)

As explained in the SER, graduates receive a certificate, a transcript of records detailing all courses completed, the credit hours and grades differentiated by semester and year.

Experts' evaluation

In general, the requirements, prerequisites and processes for admission and certification are transparently documented. The same applies to the collection of data on student progression; using a software for administering the collection and also to use these data in quality assurance processes is adequate.

Also, the experts can confirm that KNUST is a public university and is legally entitled to award PhD degrees.

The experts point out that it is not very satisfactory that there are no official regulations on recognition. However, the experts learnt from students and graduates that such requests are taken seriously, and that the support system is appropriate. While non-formal and prior learning can be recognised on an individual basis, this practice leaves room for improvement.

Universities want to be recognized worldwide and add experts in the different fields they teach to the market. In the same way students want to be seen as experts in their fields and want to put themselves into learning systems worldwide. This is a huge advantage for universities but for students also. Therefore, it is highly recommended that students get an additional paper/certificate on graduation that integrates their certificates in the national framework (e. g., comparable to the Diploma Supplement used in many countries of the European Higher Education Area) (**finding 13**). This would give many more options to support the exchange of students and experts between different tertiary institutions within Ghana and beyond national borders. Besides explaining the higher Education system in the country, it should also contain information on the grading system. This may also foster internationalisation, e.g., by attracting students from other countries as incoming students for a certain period of time (one to two semesters), and it may also to support international mobility of KNUST students.

Another opportunity for international recognition comes with an instrument of recognition of credits of external/other institutions and agreements with external/other institutions on recognition. Therefore, KNUST as a whole should think about defining criteria and processes for recognition of achievements gained at other universities.

Conclusion

The criterion is fulfilled.

5. Teaching staff / Academic level of supervisory staff

Bachelor's/Master's degree

The composition (quantity, qualifications, professional and international experience, etc.) of the staff is appropriate for the achievement of the intended learning outcomes.

Staff involved with teaching is qualified and competent to do so.

Transparent procedures are in place for the recruitment and development of staff.

[ESG 1.5]

Doctoral degree

The composition (quantity, qualifications, professional and international experience, etc.) of the staff is appropriate for the achievement of the intended learning outcomes.

Staff involved with teaching is qualified and competent to do so.

Transparent procedures are in place for the recruitment and development of staff.

[ESG 1.5]

Description

General aspects

At the Registrar's Office, there is the Staff Training and Development section at university level which is responsible for ensuring adherence to relevant policies on sabbatical leave, study leave, leave of absence, secondment etc. It also plans and organises staff training and development programmes and prepares memoranda on training and development related issues, e. g. for promotion. The section also holds responsibility for preparing annual reports on staff training and development for the Academic Board. The section is part of the Human Resources Development Division which is a unit of the KNUST Registrar's Office. It is also responsible for staff recruitment processes. Besides organising training for the teaching staff, one of the unit's tasks is instituting a system for continuing education and in-service training for all employees of the university.

a) Department of Electrical Engineering

Description

Following the SER, the Department of Electrical Engineering includes two associate professors, two part-time adjunct professors, two senior lecturers, two lecturers, two technicians, one support staff member, and one administrative staff member.

Experts' evaluation

A list of the teaching staff with their academic qualification and indicating if they are full-time or part-time permanently employed as well as information on their length of affiliation was provided. However, not all information on the teaching staff including research projects and publications were accessible on the homepage of the department at the time of the experts' evaluation because the page was under construction. The experts assume that all information will be available (again) on the homepage in the future.

Also, the experts conclude that the teaching staff is usually sufficient to offer the programmes under review due to the discussion on site. In case of the PhD programme “Electrical Engineering”, they are qualified and dedicated to support students in their dissertation. Additional to the university’s teaching staff, one of the post-graduate courses in the Master’s and PhD programmes is taught by a part-time lecturer from the industry (“Power Systems Protection”) which also fits the common German practise to integrate experience from the industry for specialized courses.

The workload of the lecturers is 40/hrs per week in the programmes which is very high because they also teach undergraduate students at another campus and provide online courses at the weekend, which adds to the workload. Therefore, support by additional lecturers and teaching staff is necessary for a successful implementation. However, what adds to the problem is that the experts were informed that open positions cannot be filled because not enough adequately qualified lecturers could be recruited. The management is fully aware of these shortcomings. The problem they face is that PhD graduates stay abroad, mainly in the US, or that prospective PhD students decide to gain a PhD abroad – and then stay there. Building capacity within the university is difficult, “in-breeding” is not desired, therefore graduates are sent away for further education and do not come back or start working in the industry because of the higher salary and the lower workload. There are attempts to attract more students to stay at the university by funding and giving scholarships. One aim of the MPhil and PhD programme is to educate future teaching personal, but this then is mainly done for other Ghanaian universities since “in-breeding” is not desired. Because there is no national competitor in the field of the programmes, there are no collaborations with other universities KNUST could interchange staff with. To solve the problem, at least in the long run, it is suggested to establish Memoranda of Understanding with higher education institutions in Africa with a similar standing and expertise to establish initial steps of expertise exchange (**finding 14**).

So far, the programmes still can be offered by the teaching staff, albeit at the cost of their own free time, as it seems, and this is only possible because the teachers are so dedicated. This might be a temporary condition until a new campus is built which will be served by an own group of teaching staff, as the experts learnt on site. However, in order to be able to finally assess whether the framework conditions are sustainable for the duration of the desired accreditation period of the programmes under review, the department has to develop a strategic plan how to find alternative ways to fill open positions, e. g., by considering external lecturers from the industry or from abroad to strengthen the number of teaching staff (**finding 15**). This finding applies to both programmes offered by the department.

An aspect that is to be highlighted is that the department gives funding so that the staff can attend international conferences.

The qualification of the staff in teaching and research allows to have the right skill set in order to meet the teaching demands requested to ensure high quality teaching and training for the students in both programmes. In Ghana, nobody can become a lecturer without having a PhD and working experience of at least four years when becoming a senior lecturer. Therefore, the qualification of the teaching personal is given. The responsibilities as well as the rule of external supervisors involved in staff recruiting is clearly defined by the rules of KNUST. Also, the further qualification of staff is ensured by the rules of KNUST and the respective central unit mentioned in the description. The regulations and responsibilities fit international standards. This applies to all programmes under review in this procedure.

Conclusion

The criterion is partially fulfilled.

b) Department of Mechanical Engineering

Description

The Department of Mechanical Engineering consists of one professor, six associate professors, nine senior lecturers, nine lecturers, one assistant lecturer, and five part-time lecturers. Also, it is outlined that the department has six full professors, three associate professors, nine senior lecturers, and seven lecturers for the Master's programme "Renewable Energy Technologies" and the PhD programme "Sustainable Energy Technologies". The department also has thirteen technicians, two part-time technicians, and two administrative staff members.

Experts' evaluation

KNUST has provided a full list of teaching staff involved in the Master's programme "Renewable Energy Technologies" and the PhD programme "Sustainable Energy Technologies". All staff members are appropriately qualified because they all have completed a PhD programme in an energy-related research topic. Seven staff members are professors; as such, the supervision capacity for PhD students can be identified as very good. Two out of these professors were appointed in universities abroad, one in the USA (University of Arizona) and one in Norway (NTNU) and can provide a solid international exchange structure for the Master's and PhD students in that way. These professors regularly visit Ghana for local supervision of PhD students and for teaching.

On paper, the number of teaching staff in total suits the student body of both programmes, however, since the staff also teaches in other programmes, the actual educational workload per staff member is at the very high end. Most staff are permanently appointed, and the external labour market in Ghana is weak (at present, the country experiences the biggest economic crisis in their history) which implies that teaching staff will probably remain available in the forthcoming years. Thus, the Department of Mechanical Engineering does not face the same problems as described above for the Department of Electrical Engineering.

All supervisory staff must have a doctor's title and is at such experienced with conducting PhD research themselves. Also, clear regulations and protocols are in place which define the roles and responsibilities of supervisors as well as those of external supervisors/examiners in the PhD programme.

Recruitment procedures for teaching staff are well defined and transparent. The same applies to the KNUST unit responsible for staff development. Unfortunately, the high educational workload in combination with lack of resources (as well as time) for internal staff development programmes has caused a situation which makes the execution of research of the department's staff a daily and long-term challenge. It is therefore concluded that the development of KNUST based staff should be strengthened towards research-oriented positions in the department's programmes (**finding 16**).

Conclusion

The criterion is fulfilled.

6. Learning resources and student support / Support and research environment

Bachelor's/Master's degree

Appropriate facilities and resources are available for learning and teaching activities.

Guidance and support is available for students which includes advice on achieving a successful completion of their studies.

[ESG 1.6]

Doctoral degree

Guidance and support are available for students which include advice on achieving a successful completion of their studies.

Appropriate facilities and resources are available for learning and research activities.

[ESG 1.6]

Description

Learning resources

According to the SER, students of the programmes have lecture rooms and study rooms at the College of Engineering at their disposal. In addition to the central library at KNUST, the College of Engineering has its own library with books, catalogues, and journals. It is said that the overall fee covers the library expenses.

The College offers thematic laboratories in the departments. These laboratories are available for teaching and the demonstration of experiments. In addition, other laboratories on the campus can be used for student's research activities.

Student support/Research environment

As described in the SER, the programmes are currently supported by the World Bank's fund through a loan facility to the Ghanaian government. This enables ACE KEEP to offer scholarships that cover tuition fees and research costs to international students as well as to exceptional national students. Local and international students who are not shortlisted for scholarships may be offered admission fee-paying or self-financing.

According to the SER, at the beginning of the programmes, students are offered orientation and introductory events, e. g., by the ACE KEEP management and the departments. This presentation includes an explanation of the courses for each programme and includes a walk through the campus.

Students are said to be generally informed via e-mail, telephone calls or the programme's website about relevant information and possible changes. Students can also get information from the KEEP secretariat and the departments. The KEEP secretariat publishes teaching schedules, schedules on oral presentations, advises on internship placements, or research interests of staff. Consultation hours can be booked by the students if required. International students and exchange students can receive information on travelling, transportation arrangements, security, accommodation options, the culture of the country, and similar information.

According to the SER, KNUST offers support to students with disabilities or with special life situations and has a special counselling unit to advise these students.

Experts' evaluation

Learning resources

a) Department of Electrical Engineering

In general, the existing resources available for the programmes and students' research are just about sufficient. However, the resources in laboratories (Power Lab) as well as access to licenses for required computer software need to be improved.

For example, the number of MATLAB licenses available does not fit the number of licenses needed to allow that every student can work with it on his/her own. The same applies to other software that is regularly needed in teaching, learning, and research, such as PSSE and AutoCAD. Therefore, a clear regulation of software distribution is needed. It has to be ensured that students have sufficient access to licenses for software that is generally used in the courses and for research, when needed (**finding 17**).

A positive aspect regarding laboratories and equipment is that there are collaborations with companies, so students can get experience directly in the labour market and can use the facilities there. However, the Power Lab at KNUST which the experts visited does not meet the current standards to ensure adequate teaching, learning, and research on campus. The equipment needs to be updated. Thus, a renewal of the Power Lab is required to ensure students' exposure to up-to-date technologies relevant to the curriculum (**finding 18**). KNUST must purchase suitable equipment to fulfil the criterion and must hand in appropriate evidence on which new equipment was bought and how it is used in the programmes (e. g., photos/videos and explanation on usage in the courses).

Conclusion

The criterion is fulfilled.

b) Department of Mechanical Engineering

Teaching facilities, in the sense of rooms and space, are abundantly available and well equipped, but the research laboratories, though space and technical support staff are available, do not yet meet the common standards regarding daylighting, interior lighting, ventilation, and furniture.

Moreover, it should be ensured that access to equipment and technologies is available to the students in the Master's programmes "Renewable Energy Technologies" and the PhD programme "Sustainable Energy Technologies". This includes, e. g., monitoring equipment such as dataloggers, advanced laptops, irradiance sensors, IV-curve scanners, weather stations, demonstrators, or energy components for biomass energy, wind energy, and solar energy projects. Namely, practical equipment and energy components are required to be able to gain experience and to conduct experiments with current and emerging renewable energy technologies. However, the experts are well aware that supplementing this missing equipment is challenging and will require a financially viable plan. However, access to practical equipment in emerging technologies like those mentioned before is recommended (**finding 19**).

Computer workplaces, though their numbers are limited, seem well equipped, however most students own a personal laptop. The library provides digital access to several publishers such as, e. g., Wiley & Sons, Elsevier, IEEE, MDPI, Springer, which enables reading and learning from international literature. Locally, all textbooks used in courses are available to Master's and PhD students. The library has several hard copies of each textbook.

Conclusion

The criterion is fulfilled.

Student support

The provided learning resources, besides the lack of some equipment as indicated above, seem coherent with the need of the students. The library provides mainly digital access to journals and e-books. It also offers courses for scientific writing, publishing and literature research, including referencing software and citation rules, which are available for the students of the programmes under review.

In the main library, a dedicated post-graduate workspace – providing free learning places, computer stations, a conference and lecture room – is available to students. Also, the library of the Engineering College and the laboratory spaces of the KEEP building are equipped with PC stations, which are reserved for the students enrolled in the programmes.

Nevertheless, most students do not possess a personally assigned and permanent workplace, allowing them to work in a continuous environment. This, however, can be of great help for the student's dedication and productivity, especially in the last phase of project work. The departments should therefore consider planning office places dedicated to PhD students and potentially include places for Master's students during their final phase of the thesis (**finding 20**).

The panel acknowledges that currently an important part of students in the programmes benefit from scholarships, allowing them to cover basic living expenses while focussing on their studies. Other students are working while pursuing their studies. Especially for PhD students, the experts are concerned that without sufficient funding to cover living expenses and admission fees, students might not have enough time to pursue their research work. As a solution, the different departments are already acquiring different funding sources to cover admission fees and research expenses of PhD students. The panel encourages the departments to follow this path and to potentially establish industry funded research projects for PhD students.

The KNUST campus offers different student housing, sport facilities, religious spaces, and infrastructure for student life. The Graduate Students' Association participates in the animation of student life in Kumasi and represents the students' interest in the relevant university boards and committees. However, despite the large campus space, the on-campus housing cannot cover all demand and especially post-graduate students move to off-campus housing. Unfortunately, for those students the public transport options are limited, especially in late hours.

Within the KEEP programmes under review, 30 % of the admission capacity is reserved for international students, subsequently the student body consists of students from all over West-Africa. International students were able to assure the expert panel that they were welcomed and assisted by the institution upon their arrival in Kumasi. The international spirit of the programmes is one of its strengths and should be enlarged to incoming students from beyond West-Africa in the future.

The university can understandably not yet provide funds for student mobility, so that any type of student mobility has to be mainly self-funded. However, the departments possess funds for participation in conferences for which PhD students can apply. The experts understand that the financial situation does not permit a recurring participation in international conferences or summer schools (for all students) but acknowledges the strong dedication of the departments to organise international internships and short-term research stays for young staff members and PhD students who want to spend some time abroad.

The department offers teaching assistant positions for PhD students who want to pursue an academic career and therefore would like to gain experience in teaching and supervision. Although not all PhD students can get a paid teaching assistant position, the departments assured the expert panel that teaching competences can still be acquired by those PhD students who wish to do so. The experts noticed that the demand for such assistant positions by postgraduate students is high and encourage the department to make as many positions available as they can. These positions should ideally include remuneration for teaching activities.

Conclusion

The criterion is fulfilled.

7. Public information

Bachelor's/Master's degree

Impartial and objective, up-to-date information regarding the programme and its qualifications is published regularly. This published information is appropriate for and available to relevant stakeholders.

[ESG 1.8]

Doctoral degree

Impartial and objective, up-to-date information regarding the programme and its qualifications is published regularly. This published information is appropriate for and available to relevant stakeholders.

[ESG 1.8]

Description

According to the SER, information on the programmes is published on the ACE KEEP homepage which covers sub-pages for the departments. The programmes are also announced in print media and on the KNUST homepage during the admission window. As described in the SER, the information published consists of admission requirements, the application window, funding opportunities, and contacts for enquiries. This information can, e. g., be found on the homepage of the Post-Graduate School of KNUST.

Experts' evaluation

It is necessary that all relevant information regarding the university and the study programmes can be found on the homepage of the university and/or the Post-Graduate School, respectively. The homepages should be used for marketing reasons of the university and the programmes, and to inform the public as well as certain target groups, e.g., current and prospective students. The information needs to be updated constantly and all current courses and curricula, regulations, policies, and prerequisites for applications need to be published and be easily accessible. Mainly, this seems to be ensured by the main homepage of KNUST and the homepage of the Post-Graduate School of the university.

Additionally, the experts found the ACE KEEP homepage a central source of information, its programmes, and research activities. Unfortunately, not all relevant information was to be found on the homepage yet. For example, the experts were unable to locate important information on policies and regulations, the current curricula of the programmes, and the research activities of each department whose programmes are under review. Therefore, the ACE KEEP homepage needs to be updated regarding the following points (**finding 21**):

- a. publication of all relevant regulations and policies that apply to the programmes (either by linkage to the information on the Post-Graduate School's website or by adding these documents on its own website);
- b. a transparent outlining of the current taught curricula of the programmes;
- c. the outlining of current research lines for the programmes.

Additionally, the experts found it confusing that for the Master's programme "Power Systems Engineering" the title is not streamlined on the departments' and the ACE KEEP's homepage; it differs between both websites which caused some misunderstandings. This might also occur when applicants want to get further information on the programmes offered (also see chapter 1.1.1, **cf. finding 1**).

Conclusion

The criterion is partially fulfilled.

V. Findings

Commendation:

The experts have gained a good impression of the study programmes that are jointly evaluated in this procedure through the discussions and the guided tour on campus. Many questions that had arisen in advance could be clarified during the site visit. This was made possible above all by the open and friendly discussion atmosphere in the various rounds.

The experts were convinced by the high motivation of the teaching staff and those responsible for administration in the different departments involved in the programmes under review. They appeared to be highly motivated to offer the students a good study programme, to support them, and to create suitable framework conditions with the available resources.

Another positive aspect was, for example, the fact that lecturers from Ghana with international expertise are involved in the study programmes “Renewable Energy Technologies” and “Sustainable Energy Technologies”.

It should also be emphasised that the quality assurance system at KNUST is well organised and that there are clear responsibilities. Surveys and development processes are carried out at different levels which contribute to the quality development of the study programmes.

Findings:

1. A streamlining of the programme’s title outlined on the department’s homepage and the ACE KEEP homepage is required for the Master’s programme “Power Systems Engineering”.
2. A better coordination between the different lecturers and a more transparent system of available topics for the assignment of Master’s thesis topics is required. The department should develop a respective concept.
3. The course descriptions of all programmes under review have to be revised outlining the assessment methods of the courses.
4. Evaluation results should be directly discussed with the students of the course to close the PDCA cycle and to increase acceptance and ownership of the QA cycle.
5. The intended learning outcomes of the PhD programmes must be defined with a clear reflection of level 8 of the European Qualifications Framework.
6. For the Master’s programme “Renewable Energy Technologies”, it is advised to implement courses on emerging technologies, such as solar fuels. These courses should also cover adjacent topics which are relevant of decentralized energy systems and hybrid systems, such as courses on energy storage technologies, smart energy management technologies, and electric mobility.
7. For the Master’s programme “Renewable Energy Technologies”, it is advised to update the reading lists of the courses with at least one additional recent publication, report or book.
8. Considering finding 9 and in order to better align the PhD programme “Sustainable Energy Technologies” with European standards of appropriate PhD theses (and to enhance the visibility of PhD research in the international research community), it is advised to publish research results that originate from the PhD programme in at least two manuscripts to be submitted to accredited scientific journals with an impact factor.
9. The university, together with the faculties, should develop a set of rules for scientific publishing in advance of PhD theses. The university should provide the rough framework – e.g., that scientific publishing is

desired in the context of a dissertation – which is then specified in more detail by faculties, e.g., number and type of publications. It is recommended to follow international practices of the different disciplines when defining the rules, so that potentially frequently occurring, large discrepancies between internal and external reviews of PhD theses are avoided and the PhD degree is internationally compatible.

10. A clear compilation of all regulations and policies which are relevant to the Master's and PhD programmes offered by the ACE KEEP is required.
11. A stronger integration of the private sector into the advisory processes of ACE KEEP is recommended to enhance the integration of industry projects and linkage with the industry.
12. The assessment regulations should allow for more flexibility in terms of ratio between continuous assessments and final assessment. Also, the regulations should allow for choosing the formats to follow the needs of the respective department.
13. Graduates of the programmes should receive an additional document (e. g., a diploma supplement) which serves as an explanatory document on the Ghanaian higher education system and the grading system, especially to foster internationalisation and mobility of students.
14. The Department of Electrical Engineering should establish Memoranda of Understanding with higher education institutions in Africa with similar standing and expertise to establish initial steps of expertise exchange.
15. For the Master's programme "Power Systems Engineering" and the PhD programme "Electrical Engineering", the department has to find alternative ways to fill open positions to strengthen the number of teaching staff, e. g., by considering more external lecturers from the industry or from abroad. Therefore, a strategic plan has to be developed.
16. For the Master's programme "Renewable Energy Technologies" and the PhD programme "Sustainable Energy Technologies", the teaching staff's possibilities to conduct research should be strengthened as long as the teaching load is as high as at the moment.
17. For the Master's programme "Power Systems Engineering" and the PhD programme "Electrical Engineering", it has to be ensured that students have sufficient access to software licenses regularly needed for teaching, learning, and research, such as MATLAB, PSSE, and AutoCAD.
18. A renewal of the Power Lab is required to ensure students' exposure to up-to-date technologies relevant to the curriculum of the Master's programme "Power Systems Engineering" and the PhD programme "Electrical Engineering". Appropriate evidence on which new equipment was bought and how it is used in the programmes must be provided.
19. Further practical equipment in the Master's programme "Renewable Energy Technologies" and the PhD programme "Sustainable Energy Technologies" is required to enable up-to-date research, such as access to emerging technologies (e. g., irradiance sensors, IV-curve scanners, weather stations, demonstrators, or energy components for biomass energy, wind energy, and solar energy projects).
20. It is recommended to include personally assigned and permanent working places, preferably in the building of the ACE KEEP, for PhD students who are in their research phase.
21. The ACE KEEP homepage, serving as the main source of information, needs to be updated regarding the following aspects:
 - a. publication of all relevant regulations and policies that apply to the programmes (either by linkage to the information on the Post-Graduate School's website or by adding these documents on its own website);

- b. a transparent outlining of the current taught curricula of the programmes;
- c. the outlining of current research lines for the programmes.