

EVALUATION AND ACCREDITATION DOCUMENTS

M.Sc. Chemical Engineering

Africa Centre of Excellence in New Pedagogies
on Engineering Education (ACENPEE)

Ahmadu Bello University

Zaria, Nigeria

June 2024

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International evaluation and accreditation

EVALUATION REPORT

M.Sc. Chemical Engineering

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Ahmadu Bello University

Zaria, Nigeria

March 2024

The Ahmadu Bello University has mandated the Hcéres to perform the evaluation of its Chemical Engineering M.Sc. programme. The evaluation is based on the “External Evaluation Standards” of foreign study programmes, adopted by the Hcéres Board on 31st January 2022. These standards are available on the Hcéres website (hceres.fr).

On behalf of the experts committee¹ :

Olivier Boutin, President of the committee

In the name of Hcéres¹ :

Stéphane Le Bouler, Acting President

¹In accordance with articles R. 114-15 and R. 114-10 of the Research Code, evaluation reports are signed by the chair of the experts committee and countersigned by the President of Hcéres.

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I. STUDY PROGRAMME IDENTITY SHEET

- University: Ahmadu Bello University (ABU), Zaria, Nigeria
- Department concerned: Department of Chemical Engineering
- Title of the programme: M.Sc. Chemical Engineering
- Year of creation and context: 1981. The Department was established in 1973, initially as the Industrial Chemistry Section of the Chemistry Department in the Faculty of Science. It was formally converted to the Department of Chemical Engineering and transferred to the Faculty of Engineering in October 1976. The Departmental Postgraduate programme based only on research work has started in 1981. In the 1985/86 session, the programme was expanded to include coursework in addition to the research component.
- Site where the programme is taught (town and campus): Department of Chemical Engineering, Campus Samar, Ahmadu Bello University (ABU), Zaria, Nigeria

PROGRAMME DIRECTOR

- Surname, first name: Hamza, Abdulhamid
- Profession and grade: Professor
- Main subject taught: Chemical Engineering

METHODS AND RESULTS OF THE PREVIOUS ACCREDITATION(S)

- In 2022, the programme was evaluated by the National Universities Commission (NUC). The programme has received its full accreditation by the NUC for 5 years, from March 2022 to March 2027.
- No previous international accreditation. Three other programmes from the ACENPEE (M.Sc. Civil Engineering, M.Sc. Mechanical Engineering and M.Sc. Water Resources) are being evaluated by Hcéres in 2023.

HUMAN AND MATERIAL RESOURCES DEDICATED TO THE PROGRAMME

- **Human resources**

Academic staff	Professors	Readers	Senior Lecturers	Lecturers	Total
	19	7	3	6	35
Technical staff	Senior Technologists	Assistant Chief Technologist	Technologist	Engineer	Total
	4	3	3	2	12
Administrative staff	Secretarial Assistant	Store Officer	Computer Operator	Others	Total
	1	1	1	3	6

- **Material resources:** computer lab, smart classrooms, open access and subscription to databases, video conferencing applications (Zoom, Skype, Google Meet), learning management devices, lecture theatres, laboratories (experimental process engineering, chemical reaction, materials, process control), workshops (welding and fabrication, machine tools, carpentry, electrical), Central University Library, and a functional physical Library dedicated to the Department. There is also a collection of e-books and other relevant publications. There is an e-library at the Central University Library with a large collection of current e-books, journals, patents, theses, dissertations, etc. The Central University Library has provided access to eleven commercial databases.

STUDENT POPULATION: EVOLUTION AND TYPOLOGY OVER THE LAST 4 YEARS

		2018/2019	2019/2020	2020/2021*	2021/2022	2022/2023*
Enrolment	Male	40	27	-	23	-
	Female	5	1	-	2	-
	Total	45	28	-	25	-
	<i>including foreigners</i>	0	0	-	2	-
Graduates	Male	18	6	-	26	-
	Female	3	4	-	3	-
	Total	21	10	-	29	-
	<i>including foreigners</i>	0	0	-	0	-

*Due to Covid-19 pandemic and industrial action embarked by Academic staff of Nigerian universities, Ahmadu Bello University had to cancel two academic sessions (2020/2021 and 2022/2023). No admissions were possible during these specified periods.

II. PRESENTATION OF THE STUDY PROGRAMME

1 – PRESENTATION OF THE STUDY PROGRAMME

The Centre for New Pedagogies in Engineering Education is an Africa Centre of Excellence (ACENPEE) hosted by Ahmadu Bello University in Zaria, Nigeria, and implemented as part of the ACE Project supported by the World Bank in 2019. The Centre was established to enhance engineering education by experimenting with new teaching methods, developing curricula and transferring these results into the classrooms of tomorrow's engineers. Therefore, its stated mission is to provide a world-class teaching and learning environment to promote innovation in techno-pedagogical skills and competencies for engineering education and practice. Several programmes are hosted in the Centre, such as Mechanical Engineering, Civil Engineering, Chemical Engineering and Water Resources and Environmental Engineering.

Considering the growth and development of Chemical Process Industry in Nigeria, there is a need to enhance the training of highly qualified chemical engineers at postgraduate levels. Chemical Engineers must conduct research targeted at solving societal and industrial problems; and provide community service through consultancy, entrepreneurship and research projects, mainly in the chemical industry sector of Nigeria. The main objective of the M.Sc. programme is to enable candidates with science and non-science engineering background to obtain a professional qualification in Chemical Engineering. Graduated students from the programme are expected to apply mathematical, scientific and engineering principles for the design of unitary operations and development of chemical processes, and demonstrate skills in critical analysis of engineering. Therefore, the programme proposes core courses such as Physical Transport Phenomena, Chemical Reaction Engineering, Unit Operations and Process Dynamics and Control followed along with many specialised ones (oil and gas, polymers, ceramics).

2 – PRESENTATION OF THE PROGRAMME'S SELF-EVALUATION APPROACH

The Faculty of Engineering has a committee on quality assurance, which comprises one member from each of the departments. This member is the quality assurance officer of the Department and Chairman of the Departmental quality assurance committee, comprising three members. The submitted self-evaluation report was very rich, with a lot of appendices (1746 pages) providing qualitative and quantitative data. A few additional documents were requested and received within the week.

III. COMPOSITION OF THE EXPERTS PANEL

- **Olivier BOUTIN**, Chair of the panel, Full professor, Aix-Marseille University, France
- **Ali DAOUADJI**, Full professor, INSA Lyon, France
- **Demba DIALLO**, Full professor, Paris-Saclay University, France
- **Maxime LEBRETON**, Ph.D. candidate, ENS-PSL Paris, France

Hcéres was represented by **Zakia MESTARI**, project manager, Europe and International Department.

IV. VISIT DESCRIPTION

- **Date of the visit:** the visit took place on Thursday 7th December 2023.
- **Summary of the proceedings:** before the visit took place, the self-evaluation report and numerous appendices had been received by the experts. Two preparatory meetings between the Director of the Hcéres Europe and International Department, the project manager and the panel of experts were held in Paris (13th November) and online (29th November). The on-site visit took place during one day, according to a schedule agreed between the ACENPEE, the NUC and the panel. During the visit, the experts asked for a few more documents to get quantitative data. All of these documents were received.
- **Organisation of the visit:** for security reasons, the visit was organised in hybrid mode in Abuja as the panel was not able to visit the Centre in Zaria. The Centre leaders, the programme director, the postgraduate coordinator, and some students and academics of the Ahmadu Bello University met the panel in Abuja.
- **Cooperation of study programme and institution to be accredited:** ACENPEE has been cooperative throughout the process. The self-evaluation report was sent according to the agreed schedule. The questions asked before and during the visit were answered clearly and precisely. The panel is satisfied that the conclusion reached is based on available and relevant information. Moreover, the involvement of the National Universities Commission has been very helpful throughout the process.
- **People met:** the experts' committee was able to meet with 34 people from different panels:

	Session	Audience
8:00 – 9:30	Presentation of the programme and discussion	Centre Leaders, programmes directors and their teams
9:30 – 10:30	Academic staff	Representative panel of academics from both programmes
10:45 – 11:45	Quality assurance	Quality assurance representatives
11:45 – 12:45	Alumni	Representative panel of alumni
14:00 – 15:00	Socio-economic partners and employers	Representative panel of socio-economic partners and employers
15:00 – 16:30	Students	Representative panel of students from both programmes
16:30 – 17:30	Closing session	Centre Leaders, programmes directors and their teams

V. EVALUATION REPORT

1 – TRAINING POLICY AND CHARACTERISATION

The study programme is perfectly in line with the institution's strategy and context, as part of the Chemical Engineering Department in the Faculty of Engineering. The University aims to develop programmes connected to industrial needs, especially in chemistry and petrochemistry, in Nigeria and West Africa, with a high scientific level for engineers. Indeed, a national development plan currently focuses on the recovery and processing of variable natural resources (mineral, fossil, and agriculture) in Nigeria. The programme is part of the African Centre of Excellence on New Pedagogies in Engineering Education (ACENPEE), which is common to several engineering programmes at Ahmadu Bello University. Part of the students of the M.Sc. in Chemical Engineering are enrolled in this ACE programme (38 since the programme has started, with a significant increase each year). The programme has a clear positioning in the education landscape. In the North-West of Nigeria, Ahmadu Bello University is the only one that proposes an M.Sc. in Chemical Engineering. The other Nigerian universities offering a similar programme are quite far, in the East or South of the country. Obviously, other countries in West Africa offer similar programmes, but this M.Sc. is the only one that has received the label "African Centre of Excellence". The programme is developed in a coherent and complementary manner with other study programmes in the same academic cycle, especially with other M.Sc. programmes dealing with engineering aspects within the same Faculty of Engineering (mechanics, biology, civil, water resources, etc.) and M.Sc. dealing with chemistry. In terms of continuity, there are clear cycles within the Department of Chemical Engineering, with an undergraduate programme leading to an M.Sc. degree, and the possibility of continuing with a doctorate in the same field.

Academic partners are involved at the local level with seven laboratories in the Chemical Engineering Department (Process Control, Catalysis, Chemical Analysis, Chemical Research, Physical Transport Phenomena, Unit Operations, Mechanical Workshop, and Technology Hal). These laboratories serve as dedicated spaces for students' practical work and research activities, as well as for staff research endeavours. The research activities developed in these structures are financed by funds obtained by the teaching staff by responding to calls for projects from institutions such as TETFund. Four other supporting structures are identified at Ahmadu Bello University, primarily focused on research themes such as matter analysis, materials, and microbiology. They complement the programme content. In the same state or further in Nigeria, 14 other laboratories are listed and operational to complement the research activities linked with the programme, for analysis or microbiology for instance.

The contributions of multidisciplinary are well-recognised, as reflected in general courses on Chemical Engineering, thermodynamics, process modelling, and some specialisation courses on three distinct themes: petroleum, polymers, and ceramics. Moreover, there are numerous exchanges between the different departments of the Faculty of Science, for instance for co-supervision of research projects, leading to strong interdisciplinarity. The curriculum incorporates sustainable development issues with a dedicated course on the subject (environmental management, pollutions, remediation ...). However, this course is an elective. It might be worth adding it as a core course.

International partnerships exist with some universities in the UK (Cambridge) and USA (MIT) for staff training; in Saudi Arabia (King Fahd University of Petroleum and Minerals) mainly for exchanges with PhD students and the teaching staff. A recent agreement with Canada (Toronto University) is currently being developed. However, these exchanges could be improved and more formally presented. The international academic partnerships for students' outgoing mobility are perfectly identified (universities in France, for instance INP Toulouse, United Kingdom, Malaysia, and Austria) and efficient with ten effective mobilities for internship over the last four years. Over the evaluation period, there has been little incoming student mobility. However, it must be noticed that in 2021-2022, 4 students arrived from neighbouring countries (Chad and Niger). This incoming mobility is to be developed. All incoming and outgoing students received financial support, for instance from ACENPEE (mandatory for foreign students) or the TETFund.

Regarding research aspects, the M.Sc. in Chemical Engineering is aligned with a doctoral programme in the same Department, namely, a Ph.D. in Chemical Engineering. The curriculum includes a mandatory research project, conducted under the supervision of at least two professors (and also sometimes a socio-economic partner). During the two years, each M.Sc. student must propose three scientific seminars. All the students attend these seminars, including some Ph.D. students. This research project (called M.Sc. thesis) is more intensive during the second year. Final presentation and validation are made in front of at least one external and two internal examiners. Some days of the week are devoted to this research project and to the seminars. The provided list of academic staff indicates that all professors are specialised in areas connected with the programme curriculum (process engineering, reaction engineering, oil and gas refining, etc.) and that most of them have an effective

research activity and a significant h-index, leading to good quality level of research activity. Research integrity and ethics are fully-developed and are important objectives as set out in Ahmadu Bello University documents (details are given on recruitment procedure, staff integrity, scientific publication management, etc). However, it appears that there is no direct training on research integrity and ethics at the student level, even if these aspects are embedded in most of the courses. There are neither research-based learning nor courses on research methods in the curriculum. However, M.Sc. students have access to the Central University Library, as well as a library located in the department. The university also provides access to an e-library with collections of e-books, journals, patents, etc.

The curriculum content considers socio-economic needs, as the different courses are oriented on current and future socio-economic issues linked to different economic sectors, such as oil and gas or polymers. The development of Nigerian industry, especially in chemistry, is very fast and this programme is very coherent with current and future needs of the country. At Ahmadu Bello University, it is exposed that socio-economic partners can be involved in the elaboration of the curriculum. A more formal involvement of socio-economic partners would be beneficial to the M.Sc. programme in Chemical Engineering. The continuing education is proposed through the training of part of the Dangote refinery (Lagos) staff and may be other companies. Some partnerships exist between the programme and several institutions engaged in an activity related to the programme, the Petroleum Technology Development Fund (Professorial chair in Chemical Engineering), the Raw Materials Research and Development Council, and the Tertiary Education Trust Fund, for instance. These institutions mainly provide funds for student scholarships and research grants. Moreover, two national companies are supporting the programme. Bon Affair Industries Limited, in Kaduna state, led by a graduated student from the programme provides equipment and offers internships. Dangote Refinery, in Lagos, one of the largest refineries in the world, is also offering internship opportunities for the students. Socio-economic actors give seminars, online or physically, to present their company and job opportunities. Some examples were provided during the discussions with socio-economic partners (public institutions for analysis and practical works, leather industry training and research supervision, refinery industry for internships and training of students and staff). At Ahmadu Bello University, students are trained to prepare their job-market integration at undergraduate level. It would be interesting to offer this type of training at postgraduate level.

In conclusion, the M.Sc. programme in Chemical Engineering is perfectly integrated and complementary to the other programmes offered by the Faculty of Engineering at Ahmadu Bello University. It is clearly positioned within the national and international landscape and has been awarded the “African Centre of Excellence” label (African Centre of Excellence on New Pedagogies in Engineering Education, ACENPEE). It has a highly effective research base, comprising numerous research laboratories and research projects for students to engage in over the course of their two-year program.

International partnerships have been forged, with both incoming and outgoing mobility for teaching staff and students. There are also numerous links with socio-economic partners, as the economy linked to chemical engineering (oil and gas, for example) is very dense in Nigeria. These links enable socio-economic partners, for example, to work with students, welcome them and offer them placements. The programme would nevertheless gain in strength and visibility by developing and formalising international and socio-economic partnerships further.

2 – PEDAGOGICAL ORGANISATION OF THE STUDY PROGRAMME

The study programme, its objectives and contents, general knowledge and skills to be acquired, are very well explained in the Handbook of studies of the Chemical Engineering Department, known by the students and the different audiences. In the research book given to students for their research project, different skills are listed that should be acquired (academic, technical, communication, etc.). The curriculum clearly explains the different core and elective courses, with a comprehensive description of the contents. Moreover, the different skills (theoretical as well as practical) are well explained. The programme structure enables a progressive specialisation, with core courses of main knowledge on chemical engineering and three ways of specialisation in, petroleum and gas processing, process engineering, and polymer/ceramic engineering. Additionally, elective courses are proposed to all the students of the programme. Moreover, students can choose and attend courses from other departments in the Faculty of Engineering. In this case, these courses are free and not credited.

The programme diversifies its teaching methods with lectures, assignments/homework, individual/group projects, tutorials, excursion visits and seminars/presentations, allowing to foster the students' success. Part of the courses can be provided online. Due to internet connection issues, it is recommended to systematically record these courses and make them available on a platform accessible to all students. Some trainings on industrial sites are proposed to some students. At the University level, a Guidance and Counselling Centre supports students in promoting their academic success. The Postgraduate School proposes an orientation service. At the Department level, the two supervisors who supervise the students during the two years of the

programme for research project can also informally help them. It would be interesting to develop this monitoring more systematically and formally. The training on the use of information and communication technologies is embedded in different programme courses and in the research project. In addition, students can take these courses in other departments as electives. It would also be interesting to offer more formal training on these topics.

As English is the native language of most Nigerian students, no other language is taught to students. A 6-month training in English is offered to foreign students (as French-speaking students from Chad and Niger) before starting the M.Sc. programme. Therefore, students are not sufficiently formally prepared for outgoing mobility programmes. It would be interesting to develop international mobility.

Regarding the opportunities to learn about entrepreneurship, the colloquium officer of the Department organises seminars for students, with guest professionals from private companies who talk about developing entrepreneurship and their experiences in their companies. Moreover, the department is a member of the Nigerian Society of Chemical Engineers (<https://www.nsche.org/>). This gives the opportunity for students to participate in the annual conference, physically or online. The website of this society offers access to online seminars and workshops on various professional aspects, such as safety, communication, and entrepreneurship. Students are offered two periods of professional immersion. The first is the research project, which takes place over the two years of the programme, particularly in the second year. The second period involves an internship of at least one month in a private company. This internship is mandatory for students selected in the ACENPEE program. The companies are selected and provided by the programme and validated by the World Bank. Even if the socio-economic partners sometimes offer students seminars and workshops that contribute to their integration into the job market, the programme should give them more formal opportunities to acquire skills that are useful for their integration into the labour market.

In conclusion, the structure of the curriculum is very well-designed and clearly defined, enabling students to specialise gradually. A wide range of pedagogical approaches is employed both within the University and in collaborating companies. Key highlights include the opportunity to enroll in courses offered by other Departments, especially those in the Faculty of Engineering; the two-year research placement, which provides valuable learning experiences for students; and the mandatory industrial internship for students in the ACENPEE programme. It is also worth highlighting the opportunities for transdisciplinary and diversified online conferences offered by membership of the Nigerian Society of Chemical Engineers.

Although various elements of soft skills are offered to students, these trainings are often scattered and informal. It appears essential to develop and systematise them to better prepare students for incoming and outgoing mobility, to help them acquire additional skills relevant to their job-market integration, and to master information and communication tools.

3 – ATTRACTIVENESS, PERFORMANCE AND RELEVANCE OF THE STUDY PROGRAMME

The information system of the programme is mainly based on the University Ahmadu Bello and the programme's websites, with the explanation of the different procedures. This access is satisfactory for the different types of audience. The advice is mainly available on the programme's website (<https://engineering.abu.edu.ng/department/chemeng/public/>), which is of good quality. The programme measures its attractiveness by monitoring and analysing the applications, including the origin of students. For instance, from 2019 to 2021, 83 students were from Ahmadu Bello University, 22 from eight other universities in Nigeria, and four from foreign universities (Chad and Niger). These figures reveal that while the programme is attractive locally in Nigeria, its appeal internationally is somewhat limited. The interview with some students indicates that the label ACENPEE is attractive for national and international students.

The way in which the curriculum monitors student success rates and analyses the impact could be improved. If a student fails an exam, course attendance, which must be over 75%, is checked. In the event of other problems, such as financial difficulties, students may postpone their graduation.

Regarding integration into the job market, graduate students receive a personal link to a university platform where they can directly fill in a database with their professional careers. For the first time, a significant survey was distributed to students to gauge the program's appeal more accurately. 68 responses were received, with approximately 60% coming from current students and 40% from graduates. It would be interesting to systematise this type of survey and improve its analysis.

In conclusion, the programme's information system, mainly based on the programme and Ahmadu Bello University websites, is accessible. The attractiveness of the programme is measured by the various universities that host students, both in Nigeria and neighbouring countries. The Chemical Engineering M.Sc. programme has

greatly enhanced its attractiveness. Student success and integration into the labour market are well-monitored but could be improved by a more systematic approach.

4 – ACADEMIC PROGRAMME MANAGEMENT AND CONTINUOUS IMPROVEMENT

The management of the programme is clearly defined and effectively coordinated at the level of the Department of Chemical Engineering, to which the administrative and technical staff are assigned. The different roles and responsibilities of teaching staff are clearly defined, both for the different courses and at the laboratories level. The head management of the M.Sc. degree is well identified. A schedule of duties is established at the beginning of each semester, accessible to teachers and students. Regular meetings are organised between the teachers and the postgraduate school coordinator. ACENPEE organises workshops to evaluate the efficiency of the programmes. The list of contributors to the programme and their status are known to the students thanks to the Postgraduate Chemical Engineering handbook. This document also detailed the area of expertise of each professor and lecturer.

As for human resources, the needs of the various programmes of the Centre are met, with 35 professors or lecturers, 6 administrative staff and 12 technical staff. The pedagogical resources are quite extensive, including classrooms, a seminar room, computer labs, libraries, and technological halls specifically designed for chemical engineering and analytical aspects. However, considering the provided lists and photos, it seems necessary to renew and develop the equipment, especially for practical works and research projects development. Some equipment should be multiplied to enhance the practical works, and other ones should be bought complementary with the existing ones. In addition, some equipment is used for both practical work and research activities, which is justified but can pose problems of accessibility (in addition, undergraduates also use this equipment). On the software side, many licences are available for Matlab, while open-source software is used for process simulations. It would be interesting to develop the possibility of using licensed software, such as Aspen or ASYS, even if students already take part in webinars to be trained in how to use them. During the first period of integration of newly recruited staff, they benefit from informal mentoring with senior colleagues. This mentorship goes informal after the initial period. Moreover, workshops are organised by the Directorate of Academic Planning and Monitoring dealing with work ethics. In addition, social media like WhatsApp are used to share information and experience. In accordance with ACENPEE requirements, several workshops are offered to lecturers and assistant teachers on teaching techniques. Outgoing mobility for current teaching staff is mainly for pedagogical training, for instance in UK or USA universities (MIT), (curriculum and course design, use of open courseware, empowering the teachers training). Outgoing mobility for research activities seems to be focused at Ph.D. level. Therefore, it would be interesting to develop outgoing mobility possibilities for the teaching staff.

The student recruitment procedure is clearly explained at the Ahmadu Bello University level. For the M.Sc. in Chemical Engineering, students are required to possess at least either second-class honours in Chemical Engineering from a recognized university or an upper credit postgraduate diploma in Chemical Engineering from Ahmadu Bello University. This information is also given in the handbooks. The evaluation of knowledge follows accurate procedures common to all the M.Sc. of the University, which are well described in the Quality Assurance of the University. In the case of the M.Sc. in Chemical Engineering, 40% of the courses are evaluated through a continuous assessment, and 60% with a final examination. In addition, the research notebook, given to all students to help them carry out their research project, provides a means of regularly assessing the various skills. Students are asked to complete an evaluation survey for all courses. The majority of students completed the survey, which the PG coordinator analysed. Depending on the survey results, a different lecturer may be assigned to a course. Students can also write directly to the Head of Department. Therefore, the assessment of the course is effective, but could be more systematic. The programme has defined and implemented anti-plagiarism, for the thesis report and anti-fraud measures for examinations.

A system of regular teaching staff evaluation/assessment is organised at the University level. For academic staff members, teaching competence is assessed by performance reviews by students at the end of every academic session. The questionnaire is like all programmes of the university and includes many details on course evaluation. The evaluation results are provided to the Head of Department, who informs the teaching staff on potential issues. The curriculum has consultative bodies, at the Department and Postgraduate School levels, which meet periodically. Even if some class representatives are elected and can submit requirements to the Head of Department, it would be worthwhile involving students in the different bodies. A students' union at university level can intervene and interact with the various university bodies and officials. The programme undergoes every 5 years an external evaluation by the National Universities Commission in Nigeria. The last accreditation was obtained in 2022.

In conclusion, the programme is perfectly organised around the Head of Department and the M.Sc. programme leader. The sharing of responsibilities within the teaching team is also well managed. The team consists of numerous research professors covering the broad spectrum of Chemical Engineering disciplines. The

programme offers students a wide range of teaching tools, with laboratories equipped with chemical engineering equipment combining teaching and research activities, videoconference rooms, access to physical and online libraries, and mathematical and process simulation software. However, it is important to stress that a significant financial contribution would allow for the renewal of several equipment items and the provision of access to expensive simulation software licences for students.

The different procedures for recruitment and examinations are well detailed and explained. The process of continuous assessment of the courses is effective but could be more systematic. Except through class representatives and students' unions, students are not part of different bodies (as the department council). Their contribution to these bodies would be a good way of strengthening their involvement and taking their suggestions into account in the programme.

VI. CONCLUSION

The M.Sc. programme in Chemical Engineering at Ahmadu Bello University trains very high-level engineers. Graduates have the skills and knowledge to meet international economic challenges. Particularly at the national level, in many sectors, as chemicals and oil and gas, their contribution is significant to the industrialisation of the country. The management teams (department, master and ACENPEE programme) are very involved in monitoring this programme, in a perfectly coherent and organised way.

From the recruitment process to graduation, procedures are clear, accessible, and efficient. The courses' content is comprehensive and matches the multidisciplinary of Chemical Engineering, combining fundamental courses with more applied ones. Three options are also offered, well positioned in relation to the country's industrial challenges. The research project that each student carries out over the two years is a highlight of the programme. This project, which may be experimental and/or theoretical, is supervised by several supervisors whose recruitment from other departments in the Faculty of Engineering and/or from companies highlights the interdisciplinary nature of certain subjects. This research project is monitored very rigorously over the two years, with the stages to be achieved fully documented. Therefore, all these factors help students to find their place in this programme.

The facilities offered by the programme are generally satisfactory. Laboratory equipment and chemical engineering pilot plants are numerous and varied. The access to scientific documents is good, classrooms have been recently renewed with modern communication tools, and students have access to a mathematical modelling tool (Matlab) and free process simulation software. However, to maintain and strengthen the position of the programme in relation to the worlds of research and socioeconomics, it appears necessary to receive even greater financial support from its partner institutions. This funding will be allocated towards the renewal and acquisition of new equipment, crucial for the training of chemical engineering students, as well as the procurement of licences for simulation software. These essential financial resources could also be developed by strengthening links with the socio-economic world, including alumni.

In addition, to enhance its visibility, both nationally and internationally, and to bolster its performance, the programme would benefit from a more focused approach to increasing students' awareness of international mobility opportunities and integration into the job market. This should also involve strengthening the study grants allocated to students, to enable them to work under the best conditions and limit cursus interruptions (temporary or permanent) for financial reasons. Similarly, monitoring students during their studies and professional lives, as well as contacts with former students, could be strengthened to provide further cohesion to the different classes of students. This would be a strength for the chemical engineering programme. These assessments should be seen in the context of the impact of the Covid-19 pandemic and the recent strikes of the teaching staff in Nigeria.

STRENGTHS

- The programme is perfectly in line with the university objectives, and in particular the engineering courses, in an essential economic sector in Nigeria
- The research project, spanning two years, enables students to fully immerse themselves in an in-depth and formative research process
- The resources and visibility provided by the ACENPEE programme
- The many high scientific level teaching staff
- The very well-developed curriculum, which meets many of the needs of the targeted socio-economic partners

WEAKNESSES

- The lack of financial resources for various needs, including scholarships to facilitate student work, development of research activities, upgrading of pilot equipment, and access to simulation software
- The still limited international relations, visibility, and partnerships
- The limited follow-up of students during their studies, and after their integration in the job market
- The optional internship (except for ACENPEE students) and the too short minimum duration of one month
- The lack of courses on ethics and scientific integrity, and communication

RECOMMENDATIONS

- To obtain more substantial funding, strengthen and multiply responses to calls for projects, solicit the partners from public institutions, and strengthen partnerships with the socio-economic world, including alumni.
- Develop the number of collaborations with programmes and research units abroad, to further increase the number of incoming and outgoing mobilities, as well as the involvement of foreign academics.
- Develop more ongoing and formal follow-up of students and alumni, and strengthen the programme with training on soft skills to promote integration into the job market.
- Make the internship period in companies mandatory for all students of the Master and increase its duration, with related scholarships, and thus strengthen links with socio-economic partners.
- Set up courses, seminars, and workshops on scientific integrity and ethics, and communication.

VII. COMMENTS OF THE INSTITUTION



AHMADU BELLO UNIVERSITY **ZARIA, NIGERIA.** **OFFICE OF THE VICE-CHANCELLOR**

Vice-Chancellor: Professor Kabiru Bala, BSc.(Hons) Building, M.Sc. (Bldg.Serv.), MBA, PhD (Const. Mgt.) (ABU), FNIJIB, MAPM, MCABE, C. Bldg E, MICIArb
VC/REL/43 16th May 2024

Mr. Stephane Le Bouler,
Acting President,
Higher Council for the Evaluation of Research and
Higher Education (HCERES), 2 rue Albert Einstein, 75013 Paris.
France

Dear Sir,

RESPONSE TO OBSERVATIONS FROM INTERNATIONAL GAP ASSESSMENT FOR M.Sc CHEMICAL ENGINEERING PROGRAMME

I write to acknowledge the gap assessment report on M.Sc. Chemical Engineering programme sponsored by Africa Centre of Excellence on New Pedagogies in Engineering Education (ACENPEE), Ahmadu Bello University, Zaria, Nigeria.

The recommendations are well noted and the University administration through the relevant academic organs will ensure that close monitoring of the students will be carried out to better understand the high number of students not graduating and hence reverse the trend.

The curriculum will be reviewed to include seminars, workshops on scientific integrity, ethics, sustainability, with training on soft skills to promote better integration into the job market meeting the dynamic needs of the industry and socio economy. Some of these courses will be handled by professionals from the industry.

The department will be encouraged to develop collaborations with programmes and research units internationally, to further increase the number of incoming and outgoing mobilities for faculty and students, as well as the involvement of foreign academics.

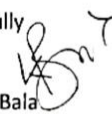
A mandatory internship for all students with increased duration, rather than the present one-month for selected students will be incorporated in the training program which will help to strengthen links with socio-economic partners.

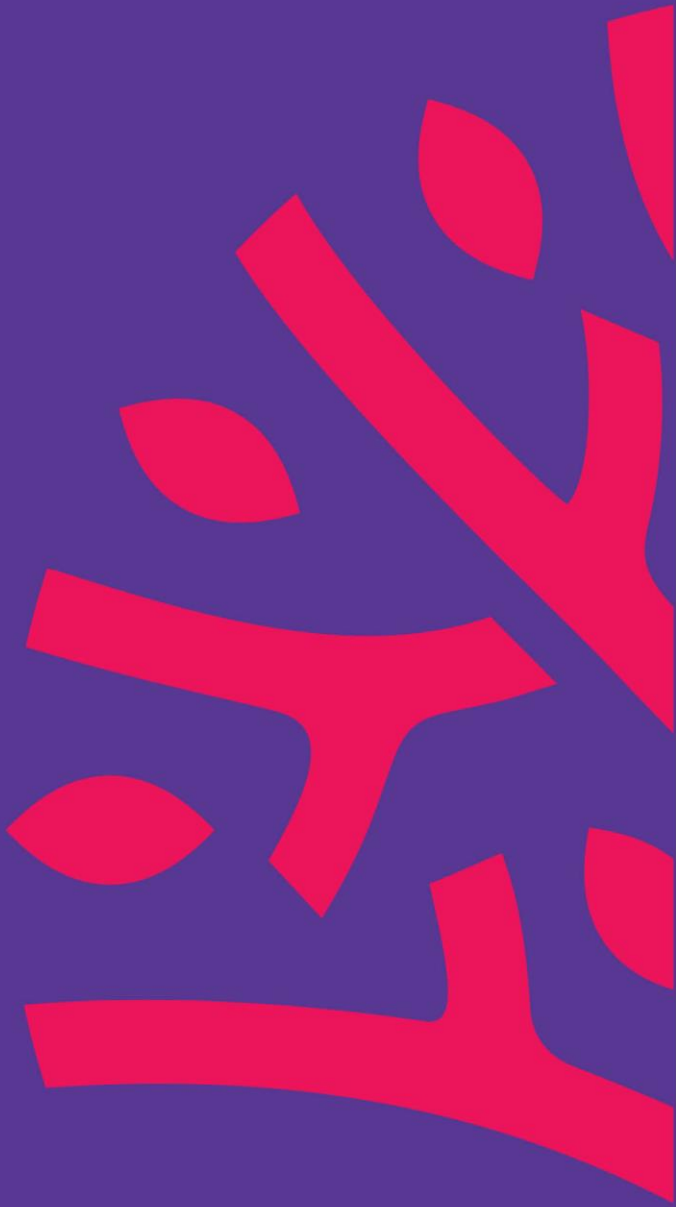
The departmental website will be continuously updated with current information about the departmental programmes, teaching and research facilities, members of staff, students, and alumni to increase the program visibility.

Financial support will be sought from relevant government funding agencies and private sector to provide scholarship and research grants to be able to attract more national and foreign students as well as maintain and purchase new equipment and software's, for training.

Finally, an annual monitoring evaluation will be carried out to check progress.
Accept my highest regard.

Yours faithfully


Prof. Kabiru Bala
Vice Chancellor



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ACCREDITATION DECISION

M.Sc. Chemical Engineering

Africa Centre of Excellence in New Pedagogies
on Engineering Education (ACENPEE)

Ahmadu Bello University

Zaria, Nigeria

June 2024

SCOPE OF THE ACCREDITATION GRANTED BY HCÉRES

HCÉRES has based its evaluation process on a set of objectives that study programmes must pursue to ensure recognised quality within France and Europe. These objectives are divided up into four accreditation criteria.

The Accreditation Commission issues an opinion about the accreditation of the study programme after examining the file. The Hcéres President takes the decision based on the Commission's opinion and the final evaluation report of the programme. This accreditation decision, taken in plenary session, is the result of a collegial and reasoned process.

The decision issued by Hcéres regarding the accreditation of the study programme corresponds to the awarding of a label to the evaluated entity.

This decision is independent of the accreditations carried out by the French State and therefore does not entail recognition in France of the institution or the diplomas delivered by it.

Decision No. EI-2024-30 on the accreditation of the M.Sc. Chemical Engineering, delivered by Ahmadu Bello University, Zaria, Nigeria

The President of the High Council for the Evaluation of Research and Higher Education,

Considering the Research Code, in particular Articles L. 114-3-1 to L. 114-3-6;

Considering the Board's deliberation of 29th September 2022 on the accreditation criteria for courses abroad (excluding doctoral/PhD programmes);

Considering the Decision No. 2023-9 of 16th March 2023 on the international accreditation procedure of the High Council for the Evaluation of Research and Higher Education;

Considering the agreement DEI_2023_CONV17 of 14th June 2023 for the evaluation/accreditation of fourteen training courses, delivered by six Centres of Excellence in Nigeria;

Considering the opinion issued by the Accreditation Commission on 18th June 2024;

Decides:

Article 1

Noting that the M.Sc. Chemical Engineering delivered by Ahmadu Bello University in Nigeria meets the four accreditation criteria, voted by the Board of the High Council on 29th September 2022, as follows:

ACCREDITATION CRITERION 1: TRAINING POLICY AND CHARACTERISATION

The M.Sc. programme in Chemical Engineering is perfectly integrated and complementary to the other programmes offered by the Faculty of Engineering at Ahmadu Bello University. It is clearly positioned within the national and international landscape and has been awarded the "African Centre of Excellence" label (African Centre of Excellence on New Pedagogies in Engineering Education, ACENPEE). It has a highly effective research base, comprising numerous research laboratories and research projects for students to engage in over the course of their two-year program.

International partnerships have been forged, with both incoming and outgoing mobility for teaching staff and students. There are also numerous links with socio-economic partners, as the economy linked to chemical engineering (oil and gas, for example) is very dense in Nigeria. These links enable socio-economic partners, for example, to work with students, welcome them and offer them placements. The programme would nevertheless gain in strength and visibility by developing and formalising international and socio-economic partnerships further.

ACCREDITATION CRITERION 2: THE PEDAGOGICAL ORGANISATION OF THE STUDY PROGRAMME

The structure of the curriculum is very well-designed and clearly defined, enabling students to specialise gradually. A wide range of pedagogical approaches is employed both within the University and in collaborating companies. Key highlights include the opportunity to enroll in courses offered by other Departments, especially those in the Faculty of Engineering; the two-year research placement, which provides valuable learning experiences for students; and the mandatory industrial internship for students in the ACENPEE programme. It is also worth highlighting the opportunities for transdisciplinary and diversified online conferences offered by membership of the Nigerian Society of Chemical Engineers. Although various elements of soft skills are offered to students, these trainings are often scattered and informal. It appears essential to develop and systematise them to better prepare students for incoming and outgoing mobility, to help them acquire additional skills relevant to their job-market integration, and to master information and communication tools.

ACCREDITATION CRITERION 3: ATTRACTIVENESS, PERFORMANCE AND RELEVANCE OF THE STUDY PROGRAMME

The programme's information system, mainly based on the programme and Ahmadu Bello University websites, is accessible. The attractiveness of the programme is measured by the various universities that

host students, both in Nigeria and neighbouring countries. The Chemical Engineering M.Sc. programme has greatly enhanced its attractiveness. Student success and integration into the labour market are well-monitored but could be improved by a more systematic approach.

ACCREDITATION CRITERION 4: MANAGEMENT AND CONTINUOUS IMPROVEMENT OF THE ACADEMIC PROGRAMME

The programme is perfectly organised around the Head of Department and the M.Sc. programme leader. The sharing of responsibilities within the teaching team is also well managed. The team consists of numerous research professors covering the broad spectrum of Chemical Engineering disciplines. The programme offers students a wide range of teaching tools, with laboratories equipped with chemical engineering equipment combining teaching and research activities, videoconference rooms, access to physical and online libraries, and mathematical and process simulation software. However, it is important to stress that a significant financial contribution would allow for the renewal of several equipment items and the provision of access to expensive simulation software licences for students. The different procedures for recruitment and examinations are well detailed and explained. The process of continuous assessment of the courses is effective but could be more systematic. Except through class representatives and students' unions, students are not part of different bodies (as the department council). Their contribution to these bodies would be a good way of strengthening their involvement and taking their suggestions into account in the programme.

Article 2

The M.Sc. Chemical Engineering delivered by Ahmadu Bello University in Nigeria, is accredited for a period of five years from the date of this decision.

Article 3

The decision is accompanied by the following recommendations and comments:

- To obtain more substantial funding, strengthen and multiply responses to calls for projects, solicit the partners from public institutions, and strengthen partnerships with the socio-economic world, including alumni.
- Develop the number of collaborations with programmes and research units abroad, to further increase the number of incoming and outgoing mobilities, as well as the involvement of foreign academics.
- Develop more ongoing and formal follow-up of students and alumni, and strengthen the programme with training on soft skills to promote integration into the job market.
- Make the internship period in companies mandatory for all students of the Master and increase its duration, with related scholarships, and thus strengthen links with socio-economic partners.
- Set up courses, seminars, and workshops on scientific integrity and ethics, and communication.

Article 4

This decision will be published on the Hcéres website.

Paris, 27th June 2024.

The acting President
signed

Stéphane Le Boulter



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