

THE INTER-UNIVERSITY
COUNCIL FOR EAST AFRICA

BENCHMARKS FOR BACHELOR OF SCIENCE IN FOOD SAFETY

July, 2022

ILRI

INTERNATIONAL
LIVESTOCK RESEARCH
INSTITUTE



Food and Agriculture
Organization of the
United Nations

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ACRONYMS / ABBREVIATIONS

BSc.	Bachelor of Science
CPD	Continuing Professional Development
COHESA	Capacitating One Health in Eastern and Southern Africa
EAC	East African Community
EAC-TWG	East African Community Technical Working Group
ELO's	Expected Learning Outcomes
EAQFHE	East African Qualifications Framework for Higher Education
EQF	European Qualification Framework
FAO	Food and Agricultural Organization
HEIs	Higher Education Institutions
ILRI	International Livestock Research Institute
IUCEA	Inter-University Council for East Africa
IUFoST	International Union of Food Science and Technology
J-TWC	Joint Technical Working Committee
NQF	National Qualifications Framework
OHRECA	One Health Research, Education and Outreach Centre in Africa
QA	Quality Assurance
WHO	World Health Organization

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FOREWORD

The Inter-University Council for East Africa (IUCEA) is a strategic institution of the East African Community (EAC) responsible for the development and coordination of higher education and research in the region. The EAC considers higher education as critical for the attainment of socio-economic development and regional integration. As such, after having been recognised as the surviving institution of the former Community responsible for coordinating the networking of universities in the region, IUCEA assumed a broader role as a building block for the achievement of sustainable socio-economic development and regional integration. In that regard, the mission of IUCEA now focuses on the promotion of strategic and sustainable development of higher education systems and research for supporting East Africa's socio-economic development and regional integration. The IUCEA has set its vision to become the leading EAC Institution for an exemplary Common Higher Education Area for a prosperous and sustainable East African Community.

Hence, in 2006 IUCEA initiated a process aimed at harmonising regional quality assurance by establishing a common East African quality assurance framework, regional quality assurance office at the IUCEA Secretariat, and setting regional higher education benchmarks quality standards based on internationally recognised frameworks. The process would also prepare a user-friendly quality assurance handbook based on existing national benchmarks and systems and streamline national and institutional quality assurance systems according to the local perspectives with the aim of promoting international competitiveness of universities in East Africa.

The initiative also focused on capacity building through providing appropriate training on the implementation of the quality assurance system to staff in universities and national commissions and councils for higher education in the Partner States. It is linked to the establishment of a regional qualifications framework. It was anticipated that the regional qualifications framework would facilitate harmonisation of education and training systems, and qualifications thereby clearly indicating the programme learning outcomes, the different qualification levels, credit system and recognition of prior learning, among others.

Therefore, the framework would easily facilitate mutual recognition of qualifications across the region as envisioned in the EAC Common Market Protocol. All these interventions contributed significantly in transforming East African Community into a Common Higher Education Area, a declaration that was made by the 18th Summit of the EAC Heads of State on 20th May 2017.

In developing the regional quality assurance system for higher education in East Africa, IUCEA in collaboration with the German Academic Exchange Service (DAAD) and the Germany Rectors' Conference (HRK) within the framework of their joint Higher Education Management support programme referred to as "Dialogue on Innovative Higher Education Strategies (DIES)", started to work on this initiative through a consultative process involving various stakeholders of higher

education in the region. The process involved holding several consultative meetings and workshops at country and regional levels, aimed at building consensus and mapping out a strategy on how to establish a regional quality assurance framework. This included the development of an operational tool in the form of a Quality Assurance Handbook. The consultative forums were also aimed at ensuring that all performance indicators and quality benchmarks were agreed upon and owned by all end-user institutions.

Additionally, IUCEA intended to develop more specific-subject benchmarks as part of the tools for the harmonisation of academic programmes offered in Higher Education Institutions (HEIs) in the region. The first benchmarks developed were for Bachelor of Business-related Studies. Subsequently, benchmarks were developed for the Bachelor of Computer Science and Bachelor of Information Technology; Bachelor of Science in Agriculture, Horticulture, Animal Science, Food Science and Technology; Bachelor of Education Programmes; Medicine (MD/MBChB) and Dentistry Programmes (DDS/BDS). Other programme benchmarks in several disciplines including Sports Sciences are at different stages of development and approval.

This publication contains benchmarks for Bachelor of Science in Food Safety. The benchmarks for the Bachelor of Science in Food Safety were developed through a consultative process involving experts from universities, industry, government agencies among other partners. The draft document was subjected to the IUCEA quality assurance processes and was approved by the Executive Committee on 4th July 2022.

On behalf of the IUCEA secretariat, it is my sincere hope and expectation that the higher education fraternity in the region will make use of these benchmarks in all educational processes and world of work to ensure that our programmes are relevant and of expected quality.



Prof. Gaspard Banyankimbona,
Executive Secretary

Kampala, July 2022 IUCEA

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I wish to extend my sincere appreciations to several individuals representing various Higher Education Institutions, stakeholders, and partners for their invaluable contributions in the development of the benchmarks for Bachelor of Science in Food Safety. I wish to particularly express my gratitude to Ms. Eleonora Dupouy and Prof. Jeffrey Lejeune from FAO, Rome for providing technical facilitation and steering the first workshop to develop the benchmarks. In addition, I am grateful to Lloyds Register Foundation, the CGIAR research programmes on Agriculture for Nutrition and Health (A4NH), One Health Research, Education and Outreach Centre in Africa (OHRECA) and Capacitating One Health in Eastern and Southern Africa (COHESA) programmes of the International Livestock Research Institute (ILRI) for their financial support for the activities of both the EAC-TWG and J-TWG in the development of these benchmarks. I acknowledge the CGIAR Initiative on One Health (Protecting human health through a One Health approach) which is supported by contributors to the CGIAR Trust Fund (<https://www.cgiar.org/funders>).

I am equally grateful to the technical team for developing and finalizing this document. The Technical Team which was EAC-TWG included Dr. Kuorwel Kuai Kuorwel of Public Health, South Sudan; Dr. Martin Ntawubizi of the University of Rwanda; Dr. Sanctus Niragira of the University of Burundi; Dr. Catherine Kunyanga, University of Nairobi, Kenya; Prof. George Nasinyama of UNICAF University – Uganda; the late Prof. Lusato Kurwijila and Prof. Rudovick Kazwala of Sokoine University of Agriculture, Tanzania; Dr. Florence Mutua of ILRI-Nairobi; Prof. Erastus Kangethe of ILRI-Nairobi; and Prof. Delia Grace of ILRI-Nairobi / University of Greenwich, UK.

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PREAMBLE

Over the years, IUCEA has developed a Regional Quality Assurance System that seeks to harmonise the quality of higher education in East Africa. The development of benchmarks is therefore an important component of this System in the harmonisation of the training in the Higher Education Institutions. The Regional Quality Assurance System is one of the key pillars in the realisation of the East African Common Higher Education Area.

The benchmarks for Bachelor of Science in Food Safety contained herein have been developed as one of the set milestones for the development of programme benchmarks. The main objective of benchmark in food safety is to provide a baseline for comparability of the Bachelor of Science in Food Safety and their graduates within and outside the East Africa Community by harmonising practice in the region. The benchmarks developed are not prescriptive nor absolute standards but serve as a yardstick or a point of reference for curriculum programme developers.

This document has been structured into three (3) parts:

- Part 1 presents the background, objectives, and the justification of need for the benchmarks in food safety. It also articulates the benchmarks development process.
- Part 2 shows the use of benchmarks. Specifically, benchmarks and qualifications, benchmarks and curriculum design and benchmarks and quality assurance.
- Part 3 provides the details of the programme in food safety focusing on the goals, expected learning outcomes, the course content for Bachelor of Science in Food Safety.

PART ONE: INTRODUCTION

1.1. Background

There has been an exponential increase in demand for access to higher education in the East African region. This increase has been attributed to the rapid growth in population and the growing need for higher education qualifications in the labour market. Such increase has led to growth of students' enrolment which is not matched to the available educational resources and has constrained the quality of provision of higher education. In addition, the liberation of higher education led to increased trend of privatization of higher education provision with some private players paying less attention to quality. As a result, the debate for the need for QA in higher education is gaining prominence among all stakeholders, including policy makers, parents, employers, and students. It is also recognized that different partner states have put mechanisms to regulate quality and standards through the Higher Education Councils and Commissions. However, the need to coordinate and harmonize efforts towards regional quality assurance has necessitated the expansion of IUCEA mandate to establish and maintain high and comparable academic standards in higher education across the region. To this end, IUCEA has put in place mechanisms to promote quality assurance and quality management.

In recent years, there has been a tremendous increase in student and staff mobility in the region which has triggered the need to institute mechanisms for comparability of the quality of education in universities in East Africa. For comparability of quality of education to be made possible, there is need for comparable programmes of study and competences. It is therefore imperative that programme benchmarks are developed to facilitate comparability of programmes of study. The development of the benchmarks on food safety seeks to popularize food safety as a fully-fledged academic programme and also achieve harmonized training programmes.

The Bachelor of Science in Food Safety benchmarks follows a similar framework of benchmarks developed by IUCEA. The Bachelor of Science in Food Safety programme benchmarks were developed by IUCEA in collaboration and support of ILRI and the United Nations Food and Agricultural Organization (FAO).

1.2. Objectives of the benchmarks

The objectives of the food safety benchmarks are to:

- i. act as a guide and tool for the HEIs in designing the curriculum for Bachelor of Science in Food Safety.
- ii. enable the National Commissions and Councils for higher education to assess the quality of the Bachelor of Science in Food Safety

- iii. promote harmonization of the Bachelor of Science in Food Safety programmes in the region.
- iv. support staff and student mobility within food safety programmes in the region.
- v. enhance the mobility of food safety professionals within the region in accordance with the EAC Common Market Protocol.
- vi. guide the labor market in making informed decisions regarding the quality and employability of food safety graduates
- vii. contribute to the capacity development a of recognizable food safety teaching workforce in the region

It should be noted that these benchmarks are output rather than learning process-oriented, focusing more on expected learning outcomes. Specifically, the outcomes are skewed towards the building of competencies by emphasizing on learner centred pedagogies. The process of ensuring commensurate curriculum content, pedagogy and assessment for the achievement of the learning outcomes is left to the Higher Education Institutions (HEIs) and to individual National Commissions and Councils for Higher Education.

1.3. Justification

Food safety is a global concern as food security cannot be achieved without access to safe and nutritious food. It is important to address food safety challenges in the region to reduce costs in public health due to foodborne disease burden, improve trade and social development.

The public health cost due to food borne disease burden globally has been estimated by WHO at 600 million cases, 420,000 deaths and 33 million disability adjusted life years (DALY) lost in 2010. Extrapolating these to African population and specifically to Sub Saharan Africa in 2018, food borne disease cases and deaths were estimated at 135 million and 180,000 respectively . In the EAC countries, WHO ratings in 2018 for age adjusted death rates due to diarrheal diseases which are mostly caused by food borne diseases were estimated at: Kenya 154.37/100,000; Burundi 134.46/100,000; South Sudan 126.22/100,000; Tanzania 85.37/100,000, Uganda 69.87/100,000, and Rwanda 56.34/ 100,000 of the population, compared to Malaria with 45.6 million confirmed cases^{2a} and 20,000 deaths in the East and Southern Africa region in 2018^b.

The cost of consumption of unsafe food is high for low and middle-income countries. The cost is often felt in different forms which may be socio economical. In Sub-Saharan Africa alone, the loss of productivity has been estimated at 16.7 billion

¹Steven Jaffee, Spencer Henson, Delia Grace, Mateo Ambrosio, and Franck Berthe (2020). Why Food Safety Matters to Africa: Making the Case for Policy Action. In RESAKSS Annual conference, Kigali Rwanda.

^{2a}WHO, World Malaria report 2018.

^{2b}WHO, Global Tuberculosis report 2020

dollars a year. For instance, the EAC countries; Kenya, Tanzania and Uganda, the cost in 2019 has been estimated at 800, 600 and 400 million dollars annually respectively. Further, the costs of treatment of the illness incurred is approximated at 15 billion dollars a year¹. The cost of intangibles associated with foodborne diseases such as preventing foodborne diseases from occurring, disruptions in markets, could increase these values considerably. In the East African Community these costs of real burden are underestimated due to high predominance of unregulated domestic (informal) markets and poor reporting.

Food safety is a critical aspect in enhancing fair trade and market access. The AU Malabo declaration projected a threefold growth in intra-African trade in agricultural commodities by 2025 . Food Safety assurance of the traded food commodities is integral to the realization of this commitment. In the second round of African Union biennial peer review process of 2020, the AU added the food safety index signifying the importance of food safety in trade between African countries. For food safety assurance of traded food commodities to be made possible, there is need for food inspectorate service. In the EAC, the number of food safety inspectors varies and thus not well distributed across the food value chains. In addition, the food safety inspectors are concentrated largely in the export and high-end markets in food commodities. Food safety experts in the region estimated that for animal source foods, fruits and vegetables intended for export and high-end domestic markets, the probability of products being inspected range from 1 in 100 to 1 in 1; while the same products destined for domestic markets (informal), the probability of these being inspected range from 1:100 to 1: 1000 . For the EAC to participate effectively in the global and other regional food commodity trade and lower the public health costs associated with food borne diseases, food safety professionals are urgently needed to manage the complex food value chains.

In cognizance of the above, the IUCEA in conjunction with ILRI, FAO and other stakeholders undertook to a process to develop benchmarks in food safety. The Bachelor of Science in Food Safety is designed to respond to global, regional and national quests for provision of safe food by developing capacities and competences of the food safety professionals.

1.4. The Benchmark Development Process

The development of the benchmarks for the Bachelor of Science in Food Safety has undergone several discussions and dialogue meetings among different stakeholders. These meetings were informed by the outputs of a number of projects including Safe Food Fair Food in informal markets by ILRI and Continuing Professional Development (CPD) in Veterinary Public Health by FAO in 2009 and 2012 respectively.

These projects showed that there was a gap in knowledge and practices on food safety in both formal and informal markets. The meetings identified strategies on how to close the gaps and this in turn led into development of CPD modules to build capacity of lower-level cadres. However, it was later realized that the CPDs were not sufficient to produce the kind of professionals needed. To remedy this, in a meeting in 2019 held in Addis Ababa between ILRI and FAO and attended by International Union of Food Science and Technology (IUFoST), University of Laval, Canada and four food safety Experts from Universities in Kenya, Uganda and Tanzania, it was agreed that a fully-fledged Bachelor of Science in Food Safety benchmarks are developed. The benchmarks are expected to also be relevant for any tertiary course covering food safety.

The meeting requested a review of programs in the EAC universities on the teaching of food safety. This document showed that there was no undergraduate program on food safety but courses (modules) relevant to food safety were being taught in programs such as veterinary Medicine, Food Science and Technology, Nutrition, hospitality management, and animal and crop science across all the regional universities. This signifies that the human capacity to train food safety professional already exists within the region and in addition, Postgraduate programs are available in a number of universities.

Following consultation with the EAC desk on Development and Social Sectors, ILRI was guided to contact the Inter University Council for East Africa (IUCEA) which is mandated to coordinate the development of programme benchmarks for harmonization of curricula in the EAC. ILRI in 2019 engaged IUCEA to discuss the prospects of the development of benchmarks on food safety.

In 2021, the process of the development of the Benchmarks formally started with the establishment of a Technical Working Group from the region (EAC-TWG) and subsequently a Joint Technical Working Group. The experts in the EAC – TWG were recruited from the premier universities, University of Nairobi, Kenya, University of Rwanda, University of Burundi and University of Juba, South Sudan, Sokoine University of Agriculture, Tanzania and Kampala International University, Uganda. The experts were persons holding specialization in Veterinary Public health, Food Science and Technology, and Agriculture. The EAC-TWG were supported by teams from ILRI, FAO and IUCEA. Meanwhile, the Joint Technical Working Committee (J-TWC) made of representatives IUCEA, ILRI and FAO. Their role was to offer guidance and mobilize funding for the development of the benchmarks.

³Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods MALABO, EQUATORIAL GUINEA • JUNE 26-27th 2014. 5 a. Commitment to Boosting Intra-African Trade in Agricultural Commodities and Services.

⁴Kangethe et al (2021). A review of the food safety architecture in the East African Community: Animal-source foods, fruits and vegetables. Nairobi, Kenya, ILRI. <https://hdl.handle.net/10568/115586>

Several meetings were held (both physical and virtual) to agree on the framework of the benchmarks. The framework focused on expected learning outcomes, core and supportive courses (modules), alignment matrix and course descriptions.

1.5. Stakeholder Engagement

The benchmarking process engaged a number of key stakeholders in consultative meetings. These stakeholders include higher education experts, professional bodies, employers and industry. The stakeholder consulted included experts drawn from the disciplines of Agriculture, Horticulture, Veterinary, Public Health, Food safety, Animal Science, Nutrition, Food Science and Technology among others. In addition, relevant departments of HEIs, National Commissions and Councils responsible for Higher Education, research organization, Government Ministries, Departments and Agencies, NGOs, professional bodies, employers and representatives of industry from all the EAC Partner States were consulted.

1.6 The E-Delphi Process

The engagement process with the stakeholders was through the Delphi process. The Delphi method involves the structuring of expert communication on complex issues. The process consists of convening a panel of experts, asking several rounds of a set of questions, and refining responses. The questions and responses are anonymous to ensure participation of all in decision-making. After each round, facilitators review responses and share the curated answers with the other experts. Once the experts hear and digest the other panellist's answers, they may adjust their own answers. The choice of experts is key in this approach. The improved document can be circulated again in further rounds (typically three) until a final document is obtained.

The Delphi method was adopted from the field of business and is widely used for planning, forecasting and consensus building. There are numerous published validations of the Delphi process with positive outcomes. For instance, it has been used in Veterinary Research by OIE (Grace et al., 2019) and in clinical education and healthcare services (Akins et al., 2005). The Delphi consensus must be aligned with evidence, context and the policy and regulatory environment.

¹Kang'ethe, E.K., Roesel, K., Mutua, F. and Grace, D. 2021. Food safety training in East Africa: A review of university courses with food safety content. Nairobi, Kenya: ILRI. <https://hdl.handle.net/10568/114571>

The Delphi process entails the use of a dedicated software. In this case, Mesydel software was used in the development of the food safety curriculum benchmarking : Based on review of literature and existing curricula, the facilitators developed and pre-tested an instrument for round one (1) of the set of questions based on five core domains of food safety as follows:

- Food production, manufacturing, retail and consumption
- Food sciences
- Food legislation and policy
- Public health
- General skills

Each Core Domains comprised several sub-domains. Experts were asked to rate their agreement with the Core Domain and sub-Domains (strongly agree to strongly disagree), then rate their agreement with the descriptions of these, then suggest improvements. At the end there was space to add any other comments or suggestions.

A total of 769 experts were identified from the EAC Partner States. From this, 308 experts were selected (Burundi 51; Kenya 74; Rwanda 51; South Sudan 107; Tanzania 65; Uganda 79) to participate in the Delphi process. The EAC-TWG facilitated the process of contacting the experts, sending reminders (two) and obtaining responses. The respondent rate was at 54% with a completion rate of 65% which was acceptable for this type of exercise. The TWG received 1060 comments from the respondents which were well detailed. Generally, there was significant consensus among experts on the Core and sub-Domains. As a result, only one round of Delphi was found to be adequate. This process informed the core and sub-domains of the benchmarks contained in the benchmarks.

In addition to the Delphi process, the TWG reviewed the existing modules, courses related to food safety with EAC, and this informed the process of developing programme objectives, expected learning outcomes, course descriptions, teaching and assessment methods for benchmarks contained herein.

⁶Grace, D., Caminiti, A., Torres, G., Messori, S., Bett, B.K., Hu Suk Lee, Roesel, K. and Smith, J. 2019. How external factors (e.g. climate change, conflicts, socio-economics, trading patterns) will impact veterinary services and the adaptations required. Technical item presented at the 87th General Session of the World Organisation for Animal Health (OIE), Paris, France, 26–31 May 2019. Paris, France: OIE. <https://hdl.handle.net/10568/108302> DOI: <https://doi.org/10.20506/TT.2984>

⁷Ralitsa B Akins, Homer Tolson and Bryan R Cole. (2005). Stability of response characteristics of a Delphi panel: application of bootstrap data expansion. *BMC Medical Research Methodology* volume 5, Article number: 37.

⁸Software and services to conduct online participatory consultations. <https://mesydel.com/en>

PART TWO: THE USE OF BENCHMARKS

2.1. Benchmarks and Qualification Standards

The benchmarks for food safety recognises the existing standards and qualifications frameworks within the respective EAC partner states. The benchmarks are not in any way a replacement of the existing benchmarks but rather to provide a regional benchmark as a reference document in the development of programmes in food safety. The benchmarks were aligned to the East African Qualifications Framework for Higher Education (EAQFHE) as well as to the various National Qualification Frameworks (NQF). In last decades, there has been significant global efforts in the development of NQFs in various countries. These NQFs may be regarded as the policy framework that defines all qualifications recognized nationally in post-compulsory education and training within a country. The NQFs comprise titles and guidelines which define each qualification together with principles and protocols covering articulation and issuance of qualifications, and Statements of Attainment. In the same spirit, the East African countries have been working on National Qualification Frameworks with various level of development. The East African Qualifications Framework for Higher Education (EAQFHE) defines Qualifications Framework as “an instrument for the development and classification of qualifications according to a set of criteria for levels of learning and skills and competences achieved.”

A review of the European Qualifications framework, NQFs in Europe and other NQFs in other parts of the world, show concerted efforts to describe the different levels of education. Qualifications Framework describe education in a spectrum from basic to higher education. The levels defined in higher education include Higher Education Certificate, Diploma, Bachelors, Masters and Doctorate. For purposes of this benchmarks, only the Bachelor's degree level is considered. Regardless of the levels defined in the various NQFs, the descriptors for the Bachelor's degree level is considered in the development of competencies, rigor of training and the expected assessment and qualification. In the EAQFHE, the bachelor's degree is defined as Level 6.

According to the EAQFHE, the holder of the Level 6 qualification will be able to demonstrate comprehensive specialized, factual and theoretical knowledge of the relevant major discipline, analyse new or abstract data and situations using a range of techniques, application of skills and understanding in a wide and unpredictable variety of contexts with substantial personal responsibility for the work of others and responsibility for the allocation of resources, policy, planning, execution and evaluation.

⁹IUCEA, The East African Qualifications Framework for Higher Education, 2015

2.2. The Benchmarks and Curriculum Design

Benchmarks are an important tool that provides guidance in the development and review of curricula in HEIs. The National Commissions and Councils for Higher Education in the EAC Partner States use programme standards and benchmarks in the assessment and accreditation of curricula. Therefore, benchmarks are required in providing guidance in harmonization of programmes, improving quality of higher education and in facilitating student mobility.

One of the key facets of Benchmarks is emphasis on learning outcomes, which are needed because they guarantee:

- i. Comparable quality levels of the graduates;
- ii. Comparable chances for the graduates in the labour market;
- iii. Labour market understands the competencies that food safety graduates possesses;
- iv. Increased national, regional, and international mobility of students; and
- v. Increased national, regional, and international mobility of staff

2.2.1. Programme Objectives

The benchmarks for the Bachelor of Science in Food Safety were designed to address the concerns of different stakeholders. Such concerns should be highlighted in the programme objectives. These objectives can be grouped into three categories:

- i. Academic ability
- ii. Employability
- iii. Personal development

The findings of the Delphi process on the existing learning outcomes of food safety courses in various HEIs in the region showed that universities in general, had not formulated programme objectives nor learning outcomes since such food safety programmes had not been previously mounted despite being taught within other programmes.

2.2.2. Formulating the Expected Learning Outcomes

One of the key steps in designing or redesigning programmes is the formulation of the learning outcomes. The purpose of the learning outcomes is to describe clearly what the student is expected to demonstrate competencies after completing the whole programme, a module or a course. HEIs are expected to compare and align their formulated learning outcomes with the benchmarks. Each learning outcome should show how it will be measured and assessed. Benchmarks therefore are formulated based on learning outcomes.

The European Qualification Framework (EQF) defined expected learning outcomes as: statements of what a learner knows, understands and is able to do on completion of a learning process, which are defined in terms of knowledge, skills and competence. A Competence, according to the EQF, is the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development. According to EAQFHE, competences are contextualized learning outcomes. Competences are fundamentally a statement of what a person is able to do after achieving a particular level of learning.

Incorporating learning outcomes in food safety programmes can improve quality of education in HEIs by building prerequisite skills and competencies of the graduates. In short, learning outcomes should not be equated to competencies but the two are not mutually exclusive. A graduate exhibiting competency at a work place will have partly acquired the skills as outcomes of his/her study, or may have been acquired from elsewhere.

It has been observed that although universities are engaged in the practice of defining objectives and measuring outcomes in one form or another, many do not approach the process of formulating Learning Outcomes in a uniform and collaborative way. It is important to note that focusing on and defining learning outcomes would create an opportunity to: -

- i. Enhance students' learning and mobility.
- ii. Provide guidance to course instructors.
- iii. Identify and overcome barriers to effective learning and teaching.
- iv. Facilitate collaboration among HEIs in the region and beyond.
- v. Improve students' learning, retention and completion.
- vi. Produce quality graduates
- vii. Increase students' chances for employability.

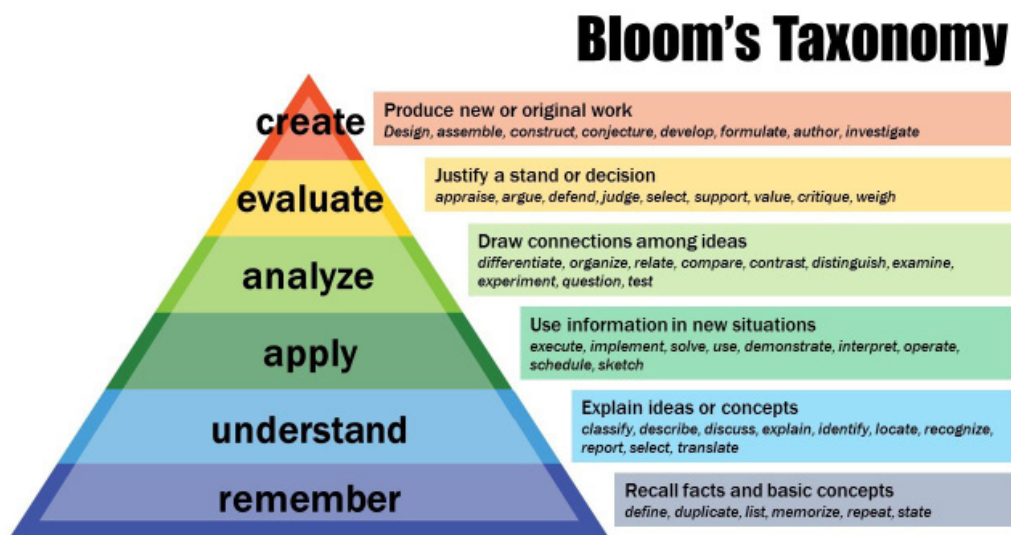
In this document, the following definition for Learning Outcomes is use

Learning outcomes are statements of the knowledge, skills and attitude that a learner is able to demonstrate on completion of a learning process.

Learning Outcomes can be separated in three domains

- i. Cognitive learning (Knowledge)
- ii. Psychomotor learning (Skills)
- iii. Affective learning (Attitudes)

In the Bloom taxonomy, the learning and teaching hierarchy is important for coherent building of the knowledge. The cognitive domain comprises six levels starting with the lowest level of remembering and ending with the highest level of creating (see Figure 1).



Vanderbilt University Centre for Teaching

Fig 1: Revised Bloom Taxonomy (Biggs 2021)

In formulating Expected Learning Outcomes one has to formulate actions, starting at the lowest level of the taxonomy. See, for examples, figure 2.

¹⁰In this context Course also means modules and units

			Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.
		Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.	Creating
	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.	Evaluating	Adapt, Build, Change, Choose, Combine, Compile, Compose, Construct, Create, Design, Develop, Discuss, Elaborate, Estimate, Formulate, Imagine, Improve, Invent, Innovate, Make up, Maximize, Minimize, Modify, Originate, Design, Predict, Propose, Solve, Test,
Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	Analyzing	Appraise, Assess, Award, Compare, Criticize, Decide, Deduct, Defend, Disprove, Estimate, Evaluate, Explain, Influence, Interpret, Judge, Justify, Opine, Perceive, Prioritize, Prove, Rate, Recommend, Select, Support, Value,	

<p>Blooms explanation of the level (in green) Blooms level Suggested verbs to use Example</p>	<p>Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas.</p>	<p>Applying</p>	<p>Categorize, Classify, Compare, Contrast, Distinguish, Examine, Function, Inspect, Factorise, Relate, Simplify, Take part in, Test for, Analyze, Discover,</p>		
<p>Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers.</p>	<p>Understanding</p>	<p>Develop, Construct, Choose, Make use of, Model, Organize, Plan, Utilize, Build, Apply,</p>			
<p>Remembering</p>	<p>Classify, Compare, Contrast, Describe, Demonstrate, Explain, Illustrate, Outline, Show, Sum</p>				
<p>What, When, Where, Which, Who, Why, Recall, List, Match, Define,</p>					
<p>Example: What is ham? How is it made? List three systems of pig production for manufacture of commercial ham</p>	<p>Describe using examples a system of pig production for regularly supplying Uchumi supermarkets with pork ham</p>	<p>Build a plan to achieve stated weekly demand of pork hams? How has your plan taken scale of production into account?</p>	<p>Categorize the outputs that can be achieved and examine material use in relation to activities for results to deliver those outputs</p>	<p>Describe the logic behind your design Will the planned inputs, activities and outputs be sufficient to deliver the scale stated?</p>	<p>Challenge your logic to see if it is robust and provide constructive ideas for improvements where applicable</p>

Fig. 2 Action words for the cognitive domain (Biggs, 2003)

Learning outcomes can be divided into:

- i. Knowledge: is the body of facts, principles, theories and practices that is related to a field of work or study. Knowledge is described as theoretical and/or factual;
- ii. Skills: are the ability to apply knowledge and use know-how to complete tasks and solve problems. Skills are categorized as:
 - a. Cognitive (involving the use of logical, intuitive and creative thinking);
 - b. Practical (involving manual dexterity and the use of methods, materials, tools and instruments);
 - c. Interpersonal (the way of communication, cooperation, etc).
- iii. Attitude: is a settled way of thinking or feeling about something. Four major components of attitude are: affective (emotions or feelings), Cognitive (belief or opinions held consciously), Conative (inclination for action), and Evaluative (positive or negative response to stimuli).

Figure 3 shows the relationships between knowledge, skills and attitude. The model is also used to categorize the learning outcomes for Bachelor of Science in Food safety.

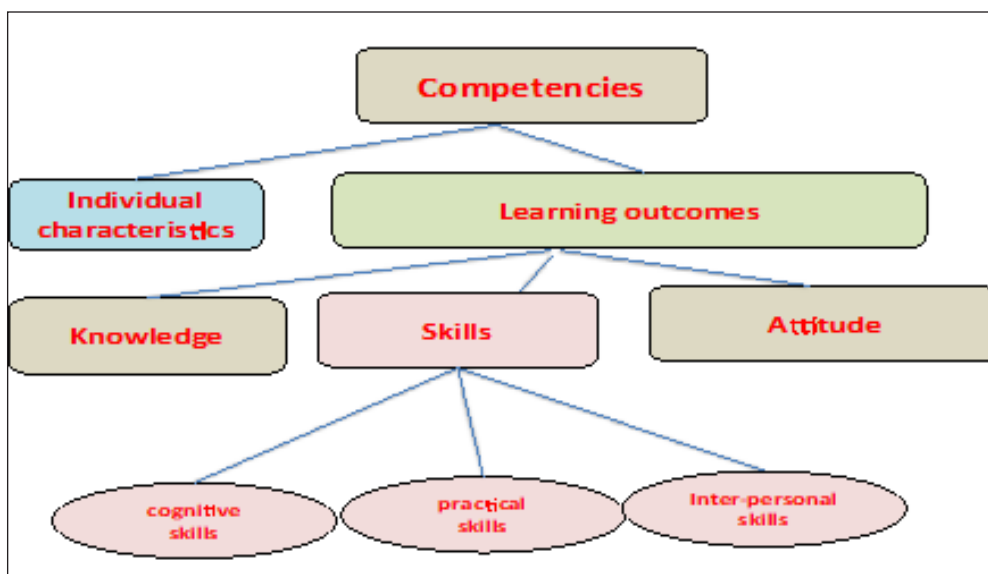


Figure 3: Categorization of Learning Outcomes

In formulating learning outcomes, a distinction has to be made between generic learning outcomes and subject specific learning outcomes. Generic learning outcomes are those outcomes expected from all academic trained graduates. Examples of generic learning outcomes should focus on: problem solving, communication skills, and ability to cooperate. A key characteristic of a generic learning outcome is that you have to practice it in a specific field. Subject specific learning outcomes are those that are typical to that discipline

2.2.3. Translating Learning Outcomes into the Programme

After the formulation of learning outcomes, the next step in the process is to identify what courses are needed to achieve the learning outcomes. A distinction has to be made between the core courses and the supporting courses. There may be several supportive courses in existing programmes and therefore programme developers need to take cognizance of such courses that may be included for the programme under development. In addition, in the review of a programme, there may be contemporary aspects that may be considered valuable to the programme and thus may be integrated.

A curriculum alignment matrix helps to check if planned courses address the learning outcomes as shown in Table 1.

Table 1: Curriculum Alignment Matrix

Academic Programme					
Learning outcomes	Course 1	Course 2	Course 3	Course 4	Course 5
Communication skills	x		x		
Critical thinking		X		x	X
Problem solving					X
Cooperate/working together	x				
Etc					

2.2.4. Course Description

The benchmarks provide the learning outcomes derived from the core courses in the programme. Higher Education Institutions are expected to develop the courses, starting with the formulation of the learning outcomes for those specific courses. For each course, the benchmarks provide a succinct and clear description. An essential part of the programme that will be developed from the benchmarks is to assess how far the student has achieved the learning outcomes. Therefore, it is necessary for the HEIs to determine how each learning outcome will be assessed.

The details of course description and assessment methods of courses in Bachelor of Science in food safety is provided in Part Three of this document.

2.3. The Benchmarks and Quality Assurance

It is now well established that benchmarks play a significant role in quality assurance of programmes. Regional benchmarks play a significant role in harmonization of quality of education in HEIs in EAC Partner States. Although National Commissions and Councils for Higher Education may apply their own criteria in assessing the quality of programmes in accreditation process, it is expected that they will ideally align their standards with these benchmarks. The benchmarks also provide a frame of reference for external assessment teams in assessing the quality of a programmes for accreditation. In addition, benchmarks offer a good instrument for HEIs in evaluating the quality of their own programmes.

2.4. Implementation of the Benchmarks

HEIs in the region are primarily responsible for the implementation of the benchmarks through the development and or review of relevant programmes. The respective National Commissions and Councils for Higher Education are responsible for oversight roles in the implementation of the benchmarks through the programme accreditation processes and monitoring activities. IUCEA will provide the overall coordination and evaluation of the benchmark's implementation process.

2.5. Review of the Benchmarks

This Benchmarks are subject to a review after every five-year period to take care of emerging trends in the specific disciplines.

PART THREE: THE BENCHMARKS FOR BACHELOR OF SCIENCE IN FOOD SAFETY

3.1. Description of Food Safety

Food safety is defined as actions/measures during production, handling, processing, storage, transportation, preparation and consumption that are taken to prevent food borne diseases and harm. Illnesses are caused by hazards in food that could be biological (bacteria, viruses, and parasites), chemicals (metals- lead, cadmium, mercury and bacterial, fungal and plant toxins) and physical (metal sharps, chips, hair). The provision of safe food is the responsibility of all stakeholders. However, the primary responsibility of food safety lies with the handler of food at any stage in a food value chain. Food safety concerns should be addressed along the farm to the fork continuum. The governments' role is to provide an enabling environment for food actors to provide safe food.

Graduates of Bachelor of Science in Food Safety programmes will be employed in the following areas: food safety inspectorate; research; food safety audit firms; Bureau of standards; food laboratories, standards and compliance, prosecution among others.

3.2. The Goal of Food Safety Programme

The goal of the Bachelor of Science in Food Safety programme is to produce graduates who are professionals in food safety who are capable of solving emerging and re-emerging challenges in food safety.

3.3. Programme Objectives

The objectives of Bachelor of Food Safety programme should be designed in such a way that they address the concerns of different stakeholders. This can be achieved by focusing on the following groups of objectives:

3.3.1. Academic Ability

The programme objectives under this category are to equip learners with:

- i. Knowledge in principles, concepts and theories in food safety
- ii. Knowledge in food safety technologies and applications.
- iii. Ability to design and implement food safety interventions.
- iv. Ability to apply skills in developing effective ways to solve food safety problems.
- v. v.Ability to adopt and adapt emerging/evolving food safety technologies.
- vi. Ability to undertake research and to progress to higher levels of studies.

3.3.2. Employability

The programme objectives under this category are to equip learners with:-

- i. Skills that enable creativity, innovativeness and entrepreneurship in the field of food safety.
- ii. Ability to adapt to current practices and trends in the food industry.
- iii. Problem-solving skills for food safety related tasks.
- iv. Analytical skills to understand impacts of food safety on individuals, organizations and society.
- v. Ability to integrate theory and practice to work effectively and efficiently in organizations.

3.3.3. Personal Development

The programme objectives under this category are to:

- i. Prepare learners for life-long learning and research.
- ii. Empower students to progress in their personal and professional career with the relevant ethics and attitude to work in multicultural and global environment.
- iii. Equip the learner with knowledge and skills to work as a team in the food safety field.
- iv. Enable the learner to develop skills to perform effectively in technical and non-technical environment.

3.4. Expected Learning Outcomes (ELO's)

To make the Bachelor of Science in Food Safety programme coherent and consistent with the EAQFHE, the following learning outcomes have been formulated to be used as benchmarks. The formulated ELO's are the threshold that all graduates of Bachelor of Science in Food Safety programme should achieve. The HEIs may consider adding Learning Outcomes as and when necessary, in line with their mission and vision or other identified need(s). Table 2 outlines the expected learning outcomes for a Bachelor of Science in Food Safety.

Table 2: Expected Learning outcomes for the Bachelor of Science in Food Safety

<p>Knowledge Skills</p>	<p><i>The graduate should be able to:</i></p> <ol style="list-style-type: none"> 1. Demonstrate knowledge and understanding of food safety hazards and risks. 2. Demonstrate knowledge and understanding of food systems and value chains. 3. Demonstrate knowledge and understanding of the practices and principles of food hygiene, health promotion and cleaning and sanitation. 4. Demonstrate knowledge and understanding of food safety standards and regulations
<p>Cognitive Skills</p>	<ol style="list-style-type: none"> 5. Analyze a food system or value chain and assess potential food safety risks. (Risk assessment) 6. Propose tailored solutions (risk management) to food safety problems and challenges, taking into account multiple criteria and factors e such as effectiveness, acceptability, and implement ability (risk management). 7. Demonstrate skills of critical analysis and review, logical thinking and reasoning, and clear and effective communication.
<p>Practical skills</p>	<ol style="list-style-type: none"> 8. Predict food safety hazards and risk in a food systems. 9. Apply risk-based approaches to prevent food safety hazards in a food system. 10. Detect food safety hazards and risk in food systems and undertake mitigation measures. 11. Design and deploy tools and approaches to Assess food safety hazards and risk in food systems. 12. Apply approaches to Control food safety hazards and risk in food systems. 13. Undertake approaches to Respond and food safety hazards and risk in food systems. 14. Communicate appropriately on food safety hazards and risk in food systems.
<p>Interpersonal skills</p>	<ol style="list-style-type: none"> 15. Work effectively as part of a team 16. Communicate, orally and in writing, effectively individuals, organizations and groups with diverse backgrounds and experiences and perspectives, both in technical and lay terms. 17. Demonstrate professional integrity, ethics, and respect for gender and cultural diversity.

Attitude	<p>18. Show commitment to the practice and promotion of food safety culture across all professional activities.</p> <p>19. Demonstrate a willingness to pursue continuing education to stay appraised of changes in technology, transitions in agricultural systems and emerging food safety threats.</p>
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3.5. Translating the Learning Outcomes into the basic phase of the Bachelor of Science in Food Safety

The learning outcomes in the Benchmarks have been translated to the Bachelor of Science in Food Safety programme and this has been demonstrated in the courses that have been outline and described in the document.

In the context of this benchmarks, a programme is understood as a coherent set of courses leading to a Bachelor of Science in Food Safety degree. The Bachelor programme may be organized in courses, modules or units. The benchmarks have structured the programme in core courses and supportive course which are easily distinguishable.

- Core courses (or subject areas)

These are the essential courses that typify the philosophy and foundation of the discipline. The core courses are the backbone of the discipline. They are the typical Food safety courses mandatory for every student.

- Supporting courses (or subject areas)

These are courses that supplement and aid the core courses without which it may be difficult to understand the core courses. Example of supportive courses include General Microbiology, Biochemistry Mathematics among others. These courses are also compulsory for all students.

Table 3 shows the core and supporting courses in a Bachelor of Science in Food Safety programme. In stating the core and supporting courses in Table 3, the following may be noted:

- The titles of the courses with regard to food safety programmes may differ from one HEI to another. The emphasis should be on content rather than title. For each core course, a short description is given for a better understanding.
- The autonomy and the uniqueness of HEIs should be taken into consideration in the formulating the supportive courses in food safety. The respective HEIs may have the choice to add their own courses beyond the core and supporting courses.

- iii. The programme may be designed in form of modules or course units as per National requirements by the Councils and Commissions for Higher Education.

Table 3: List of Core Subject areas and supporting areas for the Bachelor of Science in Food Safety Programme

Core courses	Supporting courses
<ol style="list-style-type: none"> 1. Introduction to One Health 2. Basic Principles in Food Processing and Technology 3. Biostatistics 4. Foodborne Diseases 5. Food Microbiology and Parasitology 6. Physiology, Human Nutrition and Anatomy 7. Microbiology Laboratory 8. Risk Analysis 9. Environmental Health and Climate Change 10. Food Policies, Regulations and Standards 11. Food Toxicology 12. Introduction to Epidemiology 13. Research Methods 14. Scientific Communication 15. Food Economics and Trade 16. Jurisprudence, Ethics and Food Safety Culture 17. Food Safety Surveillance 18. Crop and horticulture value chains 19. Fisheries Aquaculture and Insect Value Chains 20. Livestock, Poultry and Wildlife value chains 21. Formal and Informal markets 22. Anthropology, Communication and Behaviour 23. Food Safety and Quality Assurance 24. Food Supply Chain Management 25. Product Quality and Packaging 	<ol style="list-style-type: none"> 1. Gender social economics and entrepreneurship 2. Biology 3. Chemistry 4. Mathematics 5. General Microbiology 6. Introduction to Genetics 7. General Principles of Food Hygiene 8. Social Psychology and Behavioural Science 9. Introduction to Immunology 10. Bioinformatics 11. Biochemistry <p>General</p> <ol style="list-style-type: none"> 1. Field Attachment 2. Project

3.6. The Learning Outcomes and the Curriculum Alignment Matrix

The courses in the benchmarks have been aligned to the learning outcomes as shown in the matrix in Table 4. The Table shows how each course is alignment to a specific learning outcome.

Table 4 a: Alignment Matrix of Courses and Expected Learning Outcome* in Bachelor of Science in Food Safety

Core Courses	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Introduction to One Health	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Basic Principles in Food Processing and Technology	X		X	X		X			X			X						X		X
Biostatistics					X		X	X		X	X			X				X		X
Foodborne Diseases	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Food Microbiology and Parasitology	X	X	X		X	X	X	X	X	X	X	X	X	X				X		X
Physiology, Nutrition and Anatomy	X		X	X		X	X	X	X	X				X	X	X		X		X
Microbiology Laboratory	X		X	X	X	X	X	X	X	X	X	X	X	X					X	X
Risk Analysis	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Environmental Health and Climate Change					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Food Policies, Regulations and Standards	X		X	X	X		X	X	X	X				X						
Food Toxicology	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Core Courses	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Introduction to Epidemiology	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
Research methods	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X		X
Risk Psychology	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X
Scientific Communications	X	X	X	X	X	X	X				X		X	X	X	X		X	X
Food Economics and Trade	X	X	X	X	X		X	X			X	X	X	X	X			X	
Jurisprudence and Food Safety Culture	X	X	X	X			X							X	X		X	X	X
Food Safety Surveillance	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Crop and horticulture value chains	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X		X	
Fisheries Aquaculture and Insect Value Chains	X	X	X	X	X	X			X	X		X						X	

Core Courses	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Fisheries Aquaculture and Insect Value Chains	X	X	X	X	X	X			X	X		X						X	
Livestock, Poultry and Wildlife value chains	X	X	X	X	X	X	X	X	X	X	X	X		X					
Formal and Informal markets	X	X	X	X	X	X		X	X	X	X	X		X				X	
Anthropology, Communication and Behaviour	X		X		X	X	X	X	X		X	X	X	X				X	
Food Safety and Quality Assurance	X		X	X	X	X	X			X	X	X						X	
Food supply chain Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Product packaging	X		X	X	X	X	X	X	X	X	X	X		X			X	X	
Supportive courses																			
Gender Social Economics and Entrepreneurship		X				X	X				X	X		X	X	X	X	X	X

Core Courses	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Biology	X		X		X			X	X	X		X						X	X
Chemistry	X				X		X	X	X	X	X								X
Mathematics					X		X	X	X		X			X					
General Microbiology	X		X		X			X		X		X						X	X
Introduction to Genetics	X							X	X	X									X
General Principles of food hygiene	X	X	X	X	X		X	X	X			X		X		X		X	
Social Phycology and behaviour Science	X		X				X	X	X				X					X	X
Introduction to Immunology	X						X			X									X
Bioinformatics	X				X		X	X	X	X	X			X					X
Biochemistry	X						X			X	X								X
Projects	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Field Attachment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 4 b: Alignment Matrix of Domains to Expected Learning Outcomes for Bachelor of Science in Food Safety

Courses (Subdomains)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Formal and Informal Markets	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Food manufacturing and Processing	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Food Safety in Agri-food systems	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Consumer practices and behaviour	X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Food distribution and supply chain Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Food Microbiology	X		X	X		X		X	X		X	X	X	X	X	X	X	X	X	X	X
Food Toxicology	X		X	X		X		X	X		X	X	X	X	X	X	X	X	X	X	X
Nutrition	X	X	X			X		X	X		X		X	X	X	X	X	X	X	X	X
Risk analysis and Policy development	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Laws and Regulations	X	X	X	X			X	X	X			X	X	X	X	X	X	X	X	X	X
Epidemiology	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Surveillance	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

* Numbers 1,2,3.....in Table 4a and 4b above refer to Expected Learning Outcome as stated in Table 2 of this document

3.7. Course Description

The course description provides an ideal snapshot of the course content. It contains short and concise statements on the courses highlighting the key elements of each course. Higher Education Institutions are expected to develop details of each course stating the course aim, the course objectives, learning outcomes and the course content among others.

The descriptions of the Core and Supporting courses are provided below.

1. Introduction to One Health

The course introduces students to core concepts and historical background underlying the emerging discipline of One Health. It explores the inter-disciplinary nature of One Health and the role of the key actors within this framework, understanding of emerging disease dynamics in the 21st century, and the role of One Health in addressing emerging One Health threats such as zoonoses, antimicrobial resistance and food safety.

2. Basic Principles in Food Processing and Technology

This course introduces the fundamentals of food processing and the scientific principles of production techniques and technologies including freezing and thawing, thermal processing and canning, fermentation and dehydration. The course also covers food engineering, food safety, quality and preservation and packaging technologies.

3. Biostatistics

The course introduces students to technical skills in use of statistical tools to respond to real world food safety issues. Students are expected to design and implement a short survey related to food safety area and analyse data using relevant and available statistical software. The course will cover courses such as numerical and graphical summaries, measures of association, and hypothesis testing.

4. Foodborne Diseases

This course introduces students to major food hazards (biological, chemical and physical), their epidemiology and associated foodborne disease burden. It also covers surveillance and the link between timely decision-making and action, approaches to outbreak investigation and control of foodborne illnesses including zoonoses; food allergies/intolerance, adulterants, antimicrobial resistance (AMR), and food defence.

5. Food Microbiology and Parasitology

The course covers the biology and epidemiology of foodborne microorganisms and parasites (bacteria, yeasts, fungi, protozoa and viruses), food spoilage microorganisms; nematodes, tapeworms, and trematodes; AMR; beneficial microbes, spoilage, pathogenic, foodborne zoonoses, micro biological quality control and quality schemes; Microbiological analytical techniques and practical laboratory; microbial food ecology; Chronicity of parasite infection and its significance; Host pathology; Evasion of host responses by parasites; Serodiagnosis, vaccination, chemotherapy and drug resistance.

6. Physiology, Human Nutrition and Anatomy

The course introduces students to physiology and anatomy especially as related to food and covers linkages between food safety and nutrition, trade-offs, functional foods, food additives. It also covers under nutrition, nutritional epidemiology, nutritional surveys, monitoring and surveillance are key for food safety.

7. Microbiology Laboratory

This hands-on course introduces students to preparation of stained smears, culturing micro-organisms, conducting immunology experiments, identification and characterization of bacteria and fungi, including testing for AMR in bacteria cultures, and studying microbial growth control methods including bacterial phages in food safety.

8. Risk Analysis

The course introduces students to principles of risk analysis i.e., risk assessment, risk management and risk communication using the Codex Alimentarius and the OIE import assessment frameworks, including consumer behaviour. Quantitative, semi-quantitative and qualitative methods are outlined.

9. Environmental Health and Climate Change

This course explores the relationship individuals and populations have with their environment, and covers factors associated with the development of environmental health problems; the risk management choices made, and the resulting associations that affect health and physical well-being for the individual, communities and susceptible populations.

10. Food Policies, Regulations and Standards

The course covers food safety advocacy, inspection and audits, self-assessment, control systems, certification, SPS, Codex (one health), food standard setting/development, code of practice, and policies, standards and regulations related to food trade.

11. Food Toxicology

This course introduces students to the chemical and biological principles that determine toxicity, their properties, modes of action, and methods of analysis (physico-chemical), with typical examples of the toxic substances found in foods.

12. Introduction to Epidemiology

The course will equip students in the basic concepts of epidemiology: measuring and interpreting patterns of disease occurrence; sources of data, their strengths and limitations; study designs of disease causation; interpretation of results; bioinformatics, molecular epi, and GIS spatial analysis

13. Research Methods

This course introduces students to the elements of the research process (survey design, cross-sectional and longitudinal studies; sample size, etc) within quantitative, qualitative, and mixed methods approaches; critical review of literature; and how research findings are useful in forming understanding of their work. Strengths and limitations of different research methodologies; data analysis and reporting.

14. Scientific Communication

The course introduces the students to scientific writing including structuring articles and reports, writing effectively for both scientific and non-scientific audiences. The course also covers oral presentations, scientific reporting and use of emerging online social media in scientific communication.

15. Food Economics and Trade

The course introduces students to markets trends, market information, prices, brands; Cost-benefit analysis of food safety; economical implication of enforcing food safety measures, and lack of food safety at production, harvest and post-harvest, processing, storage, handling and preparation, and consumption of unsafe foods; trade policy and commercial law.

16. Jurisprudence, Ethics, and Food Safety Culture

This course covers the history, legal and ethical aspects of food including Food laws, right to food, food legislation, SPS agreement, food safety culture, professional ethical behaviour, and attitude toward food safety.

17. Food Safety Surveillance

The course covers methods of public health surveillance for food safety, the strengths and limitations of the data held within those systems; descriptive analyses of surveillance data and its interpretation.

18. Crop and Horticulture Value Chains

The course introduces students to crop value chains, concepts, principles and approaches; value chain development process and actor empowerment (VCD&AE). It also covers crops grown in different ecosystems, production cycles, household consumption and supply chains including production, processing, transport, storage, consumption and retail influence in food safety.

19. Fisheries, Aquaculture, and Insect value chains

This course covers farmed and captured aquatic animals (freshwater and saltwater) and insects (including honey-producing bees), production cycles, household consumption and supply chains and how terrestrial animal production, processing, transport, storage, consumption, and retail influence in food safety.

20. Livestock, Poultry and Terrestrial Wildlife Value Chains

This course covers livestock value chains, poultry, farmed and captured wildlife. It also covers production cycles, household consumption and supply chains and terrestrial animal production, processing, transport, storage, consumption and retail influence food safety.

21. Formal and Informal Food Markets

The course covers typology of food markets; regulatory requirements; the principles of food hygiene and sanitation, personal hygiene, informally vended/prepared/ready to eat foods and associated risks, food marketing, consumer behaviour and communication.

22. Anthropology, Communication and Behaviour

The course covers aspects of cultural beliefs, values, norms and traditional ways of handling food; consumer food handling and preparation; risk perceptions; food safety behaviour change, risks mitigation at consumer level.

23. Food Safety and Quality Assurance

The course covers aspects of food safety assurance programs to control biological, chemical and physical hazards and assure the safety of foods applicable to SMEs. These include prerequisite programs, HACCP, food safety management systems (FSMS) and the application of current technologies in reducing foodborne illness; national and international regulation and issues, legal and insurance issues, consumer concerns such as education, social, moral and ethical issues.

24. Food Supply Chain Management

The course covers aspects of a food supply chain, structures and food systems, management and sustainability of supply chains. The course also covers concept of food product traceability and recall (wholesale and retail); design of effective food product traceability system; and use of technology solutions.

25. Product Quality and Packaging

The course covers concepts on food product quality and management, Quality control and QC tools, Quality Assessment/Quality Control (QA/QC) programs; types and techniques of food packaging; factors that contribute to packaging decision such as access, capital, feasibility, shelf life, and market preferences.

Supporting Subject areas

These are supporting courses which are relevant to food safety.

1. Gender, Social Economic and Entrepreneurial skills:

The course covers the definition and concepts of gender, gender roles and gender analysis. The course also covers starting a business, financial risks, and exploring new business opportunities.

2. Biology

The course covers the study of living organisms and vital processes, including basics of taxonomy, morphology, anatomy, histology, cytology, zoology and botany.

3. Chemistry

The course covers the introduction chemistry, inorganic chemistry; chemistry of water; acidity and alkalinity; properties of colloids; radiochemistry; energy relations and kinetics of chemical reactions; and organic chemistry.

4. Mathematics

The course covers the basic mathematical principles and methods including set operations, arithmetic and algebra, logarithms; Equations, Matrices; Methods of differentiation, integration, exponential function, calculus, among others.

5. General Microbiology

The course covers the history and economic importance of microbiology; diversity and habitats; nutrition growth factors; media design; bacterial cell structure and morphology; microscopy; microbial culturing; isolation and identification techniques.

6. Introduction to Genetics

The course covers the Mendalian principles and gene interaction; DNA structure and replications; Chromosomes; mitosis; meiosis; linkage, crossing over and mapping; mutations; recombination fundamentals of Genome Sequencing; and genetic engineering.

7. General Principles of Food Hygiene

The course covers the five keys developed by WHO, Codex; importance of prerequisite programs in food safety at the farm/food plant; establishment hygiene; equipment hygiene; layout and maintenance; control and monitoring devices; potable water management and supply; liquid and solid waste management, and environmental hygiene.

8. Social Psychology and Behavioural Science

This course examines how individuals affect and are affected by others. It deals with how individuals think, behave, and are influenced by others. Current theories in the field will be applied to real-life situations to make sense of human behaviour. Topics covered include behaviour and attitudes, social beliefs, cultural influences, conformity and obedience, self-knowledge and self-esteem, persuasion, group influence, aggression, altruism, prejudice and discrimination, stress and health and interpersonal relationships.

9. Introduction to Immunology

The course covers innate and active resistance; humoral and cellular responses; hypersensitivity reactions and vaccinology.

10. Biochemistry

The course covers the introduction to biomolecules; biochemical processes; metabolic pathways; enzyme markers and other topics.

11. Bioinformatics

The course covers databases, sequence and structure alignment, protein structure prediction, and molecular dynamics.

General

1. Internships and/or Field Attachment

Students are required to undertake supervised practical attachment or placement which contribute to their final grades.

2. Project

Final year Students are required to design a project which is supervised and graded. The project proposals should be based on priority food safety issues, defended orally, implemented and final results presented in a report for grading.

GLOSSARY¹

Attitude	Attitude means a settled way of thinking or feeling about something
Bachelors degree	It is a degree in which the holder of the qualification will be able to apply knowledge, skills and understanding in a wide and unpredictable variety of contexts with substantial personal responsibility, responsibility for the work of others and responsibility for the allocation of resources, policy, planning, execution and evaluation
Basic phase	The first phase of the Bachelor programme, compulsory for all students (2 in a 3 years bachelor and 3 years in a 4 years Bachelor)
Benchmark	point of reference against which something may be measured
Benchmark standards	Subject benchmark statements set out expectations about standards of degrees in a range of subject areas. They describe what gives a discipline its coherence and identity, and define what can be expected of a graduate in terms of the abilities and skills needed to develop understanding or competence in the subject. (T)
Competencies	Is a product of individual characteristics and achieved learning outcomes

¹ IUCEA, Benchmarks for the Bachelor of Computer Science and the Bachelor of Information Technology Programmes, Kampala, 2015.

Core subject	These are the essential subjects offering a thorough foundation of the discipline. The core subjects are the backbone of the discipline
Course (unit)	A self-contained, formally structured learning experience. It should have a coherent and explicit set of learning outcomes and appropriate assessment criteria. Course /units can have different numbers of credits
Curriculum alignment matrix	An instrument for checking the contribution of a course, unit or module to the achievement of the programme learning outcomes
Curriculum	See programme
Elective subjects	These are subjects out of which a student has to make a selection, to deepen or to broaden their learning experience in the programme
Equivalency	Having the same value, without being uniform
Generic learning outcomes	Generic Learning outcomes are those learning outcomes, expected from all academic trained graduates, irrespective of the study programme. Examples of generic learning outcomes are problem solving, communication skills, and ability to cooperate
Harmonization	Harmonization of programmes means that the programmes in the region are comparable based on agreed benchmarks
Internship	Is a period of supervised training at the workplace and is an important part of the programme. It offers the student the opportunity to become acquainted with his /her future job. It provides the student with experiences at working floor level
Knowledge	Is the body of facts, principles, theories and practices that is related to a field of work or study. It is the outcome of the assimilation of information through learning and is described as theoretical and/or factual
Learning outcomes	Statements of what a learner knows understands and is able to do on completion of a learning process, which are defined in terms of knowledge, skills and attitude
Masters degree	It is a degree in which the holder of the qualification will be able to display mastery of a complex and specialized area of knowledge and skills, employing knowledge and understanding to conduct research or advanced technical or professional activity, able to work autonomously and in complex and unpredictable situations
Module	A formal learning experience encapsulated into a block of study, usually linked to other modules to create a programme of study

Module description	Module description is statement of the aims, objectives/learning outcomes, content, learning and teaching processes, mode of assessment of students and learning resources applicable to a block of study
National Qualification Framework (NQF)	The policy framework that defines all qualifications recognized nationally in postcompulsory education and training within a country. The NQF comprises titles and guidelines, which define each qualification, together with principles and protocols covering articulation and issuance of qualifications, and Statements of Attainment. See also Qualifications framework
Programme	A set of coherent educational components, based on learning outcomes, that are recognized for the award of a specific qualification through the accumulation of a specified number of credits and the development of specified competences. (T) (IUCEA definition)
Programme objectives	Overall specification of the intention or purpose of a programme of study (T)
Project work	Is a form of study, which is problem oriented. The project is normally based on an actual existing problem which may be linked to internship and leads to possible solutions. The project may be practical or research oriented
Qualifications framework	Is an instrument for the development and classification of qualifications according to a set of criteria for levels of learning and skills and competences achieved
Skills	The ability to apply knowledge and use know-how to complete tasks and solve problems
Standards	Explicit levels of academic attainment, which are used to describe and measure academic requirements and achievements of individual students and groups of students
Subject specific learning outcomes	Are those learning outcomes that are typical for that discipline. See also generic learning outcomes
Supporting subjects	These are subjects for backing the core subjects. Without these subjects it will be difficult to understand the core subjects
Tuning	Tuning is a collaborative, consultative process involving academics working in subject groups with employers and other stakeholders in curriculum development to enhance student competences. Tuning projects which are funded by the European Commission in higher education have been successfully completed in over sixty countries around the world



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