



Ministry of Education

Test blue print for national exit examination to be held in 2015 E.C

Band I: Engineering and Technology

Bachelor science in Food Engineering/ Food Technology and Process Engineering

Compiled by:

1. Birhanu Ayitegeb (MSc.), Bahir Dar Institute of Technology-Bahir Dar University
E-mail: birshayitegeb888@gmail.com
2. Marema Urgessa (MSc.), Gambela University, Email: maranatajesus21@gmail.com
3. Moti Dinsa (MSc.), Haramaya Institute of Technology, Haramaya University
Email: kumamotid@gmail.com

January 2023
Bahir Dar

Table of Contents

LIST OF TABLES	iii
1. INTRODUCTION	1
2. SIGNIFICANCE OF TEST BLUEPRINT PREPARATION	2
3. EXPECTED GRADUATES PROFILE	2
3.1. Knowledge	2
3.2. Skills.....	3
3.3. Attitude.....	3
4. GENERAL OBJECTIVE	4
5. SPECIFIC OBJECTIVES.....	4
6. THEMES AND LIST OF COURSES	6
7. TOTAL CREDIT HOUR OF THE SELECTED COURSES	7
8. SHARE OF THE THEMES/COURSES/ITEMS IN PERCENTAGE (%).....	8
9. LEARNING OUTCOMES IN TERMS OF THE THREE DOMAINS.....	11
10. APPENDIX.....	24

LIST OF TABLES

Table 1: The Summary of Identified Courses along with their Thematic Areas and ECTS	7
Table 2: Calculation of share of theme, courses and items from a total of 100 test items for Food Engineering program	8
Table 3: Test blueprint	11
Table 4: Name of department/ program in different Universities.....	24

1. INTRODUCTION

The Food Engineering Program aims to train autonomous professionals with the values and professional competencies to apply Scientific, Technological and Engineering knowledge to design industrial food processes, upgrade existing classical production methods, develop food products, design and manage quality systems from the perspective of sustainable social development. Graduates are trained to write up, design and execute engineering projects related to the food industry. This is all focused on the higher productivity, greater economic benefits, taking into account food security and respect for the environment.

Food engineering profession is unique among other engineering professions. All engineering profession use and manipulate mathematics, physics, and engineering art to solve technical problems in a safe and economical fashion. But Food engineering, additionally, uses the vast application of other disciplines such as food chemistry, microbiology and nutrition in order to manufacture and distribution of food products for the common good of our society. This makes the scope of Food Engineering much broader discipline.

The importance of Food Engineering program has to be greatly enhanced in scenario of the country today. Agriculture could be self-sufficient as far as productions or agricultural yield is concerned. But due to gross insufficiency of food processing, lack of proper transport & storage facilities, our farmers who deserve to be the 'greatest hero' turns out to be the 'greatest loser'. This is the reason that maximum support is offered to Agro-processing industry. In this sector, the hope of today's Ethiopian therefore is the Food Engineers who can transform agricultural raw materials to shelf stable and valuable products maintaining the quality and safety of food products.

Test blueprint is a master plan or framework that outlines/specifies the goals, learning outcomes and contents necessary to set items for a test and aligns the assessments to learning goals, outcomes and contents. It serve as a bench mark for the preparation test to ensure a balanced representation of learning outcomes and contents in the assessment.

2. SIGNIFICANCE OF TEST BLUEPRINT PREPARATION

Preparing the blueprint of exit exam for Food Engineering program is important for identifying both the percentage of tests (items) that each theme can share and the number of items per course that will appear on the exam paper. Additionally, it helps in categorizing the learning outcomes to which learning domains it belongs so as to give insight for the test developer on which domains they can give more emphasis during exam preparation. The significance of test of blueprint of the program is summarized as follow:

- To develop a representative and balanced test items for the selected courses in accordance with the competencies identified
- To guide test developers to set the test items

3. EXPECTED GRADUATES PROFILE

The following Engineering knowledge and skills are expected from the profession of BSc in Food Engineering.

3.1. Knowledge

Food engineering professionals should be equipped with professional knowledge and skill in the area and are able to employ modern technology extensively to produce and analyze food products, design food process and test how a machine or food system operates, generate specifications for foods machinery, packaging, monitor product quality, safety and control process efficiency. The following points are the identified engineering knowledge expected from Food Engineering professionals

- The ability to apply knowledge of mathematics, science and engineering to identify, formulate and solve engineering problems
- The ability to design and conduct experiments, as well as to analyze and interpret data
- Students must graduate to take pioneering, entrepreneurial and innovative roles in private and public enterprises and institutions for food processing, design and development of new products.

- Educated students capable of design and manage quality systems to obtain food products with technical and microbiological quality required as safe products and from an ecological and sustainable perspective
- Ability to integrate health, safety, and environmental issues into practical projects, economic evaluation and risk assessment, awareness of international standards and specifications.
- Enhanced problem-solving skills that involve designing and conceptual thinking and decision making

3.2. Skills

- A genuine interest in science and how it is applied to food and cookery
- High standards of cleanliness and the ability to adhere to strict hygiene rules
- Leadership qualities
- People and team working skills⁴
- Numeracy and problem-solving skills
- Good organizational ability and time-management skills
- The understanding of professional and ethical responsibility
- The ability to use information technology and communicate effectively
- Understand the impact of engineering solutions in a global economic, environmental and societal context
- The recognition of the need for, and an ability to engage in life-long learning
- Use the techniques, skills and modern engineering tools necessary for engineering practice
- Ability to create job opportunities and engaged in food business activities
- Develop skills in the functions, working principles, and solutions to different unit operations

3.3. Attitude

- The attitude to function on multi-disciplinary teams
- The understanding of professional and ethical responsibility
- The attitude to use information technology and communicate effectively

- understand the impact of engineering solutions in a global economic, environmental and societal context
- The recognition of the need for, and an ability to engage in life-long learning
- Equipped with the knowledge of contemporary issues
- The attitude towards the use of the techniques, skills and modern engineering tools necessary for engineering practice
- Attitude to create job opportunities and engaged in food business activities

4. GENERAL OBJECTIVE

The followings are the general objectives of Food Engineering program

- Check and improve safety and quality control procedures in your own and suppliers' factories, from the raw material stage through to the finished product
- Select raw materials and other ingredients from suppliers
- Compile, check and approve product specifications and labeling
- Conduct experiments and produce sample products
- Design the processes and machinery for making products with a consistent flavor, color and texture in large quantities
- Market expansion or opening of the new food industry distribution network
- Application of a food safety system
- Basic knowledge of biological science leading to an understanding and modifying / optimizing of bioprocesses
- In-depth understanding of the effects of processing raw materials on the end products acceptability, functionality and quality

5. SPECIFIC OBJECTIVES

The specific objectives of the program are:

- Educate students to effectively practice their profession to solve problems and make appropriate decisions in an efficient and timely manner.
- To produce highly qualified professionals who are capable of working in the food and beverage industries, providing consultancy service to policy and decision making.

- Demonstrate an ability to assess the most appropriate analytical procedure required for a particular food analysis problem
- Understand the science and technology involved in the conversion of cereal grains and legumes into various products and by-products
- Describe, scale up, and monitor bio reactors (fermenters)
- Execute duties regarding classification of fruits based on their characteristics, processing properties, origins and changes during maturation, maturity indices and formulate products from fruits and vegetables
- To identify the major components of food and master the procedures for food analysis
- To apply the different chemistry concepts in food product development
- Work on packaging innovation and technology
- Application of a food quality and safety like GMP and HACCP system.
- To identify and apply the rheology and electromagnetic properties for different food products.
- Develop and asses different new food products through Fortification.
- Understand production of sugar from different raw materials and converting its byproducts into different usable products.
- Understanding the production process and quality characterization of alcoholic (beer and wine) and non-alcoholic products.
- Ability to produce and analysis the physiochemical properties of edible oil from different raw materials.
- Understanding production process and characterization of different meat and dairy products.

6. THEMES AND LIST OF COURSES

I. Applied Sciences for Food Engineering

- ✓ Food Chemistry
- ✓ Food Analysis

II. Bioprocess and Basics of Food Engineering

- ✓ Fundamentals of Biochemical Engineering
- ✓ Mechanical Unit Operation
- ✓ Engineering Properties of Food Materials

III. Plant Based Food Processing Technology

- ✓ Cereals and Pulses Processing Technology
- ✓ Beverage Processing Technology
- ✓ Sugar and Coffee Processing Technology
- ✓ Fruits and Vegetable Processing Technology

IV. Animal Based Food Processing Technology

- ✓ Dairy Processing Technology
- ✓ Fat and oil Processing Technology
- ✓ Meat, Poultry and Fish Processing Technology

V. Food Packaging, Quality and Safety

- ✓ Food Quality and Safety Management
- ✓ Food Packaging Technology
- ✓ Human Nutrition and Food Fortification

7. TOTAL CREDIT HOUR OF THE SELECTED COURSES

Table 1: The Summary of Identified Courses along with their Thematic Areas and ECTS

S/N	Themes	Nº of Courses	Course Name	ECTS	Cr. Hr.	Remark
1	Applied Sciences and Food Engineering	2	✓ Food Chemistry ✓ Food Analysis	5 5	3 3	
2	Bioprocess and Basics of Food Engineering	3	✓ Fundamentals of Biochemical Engineering ✓ Mechanical Unit Operation ✓ Engineering Properties of Food Materials	5 5 5	3 3 3	BDU (5) and HU (3)
3	Plant Based Food Processing Technology	4	✓ Cereals and Pulses Processing Technology ✓ Beverage Processing Technology ✓ Sugar and Coffee Processing Technology ✓ Fruits and Vegetable Processing Technology	5 5 5 5	3 3 3 3	
4	Animal Based Food Processing Technology	3	✓ Dairy Processing Technology ✓ Fat and Oil Processing Technology ✓ Meat, Poultry and Fish Processing Technology	5 5 5	3 3 3	
5	Food Packaging, Quality and Safety	3	✓ Food Quality and Safety Management ✓ Food Packaging Technology ✓ Human Nutrition and Food Fortification	5 5 5	3 3 3	

8. SHARE OF THE THEMES/COURSES/ITEMS IN PERCENTAGE (%)

Table 2: Calculation of share of theme, courses and items from a total of 100 test items for Food Engineering program

Themes	Course Name	Credit hour	Weight of course or proportion	Number of test items from each course	Cognitive						Affective	Psychomotor	Total
					Remember	Understand	Apply	Analyse	Execute	Create			
Theme one share = 13 items from total	Food Chemistry	3	$3/6 = 0.5$	$0.5 \times 13.3 = 6$	2	2	1	1	-	-	-	-	6
	Food Analysis	3	$3/6 = 0.5$	$0.5 \times 13.3 = 7$	-	2	1	2	2	-	-	-	7
	Theme one total credit	6											
Theme two share = 20 items from total	Fundamentals of Biochemical Engineering	3	$3/9 = 0.33$	$0.33 \times 20 = 6$	-	2	1	1	-	2	-	-	6
	Mechanical Unit Operation	3	$3/9 = 0.33$	$0.33 \times 20 = 7$	1	2	1	2	-	1	-	-	7
	Engineering Properties of Food Materials	3	$3/9 = 0.33$	$0.33 \times 20 = 7$	1	2	1	2	-	1	-	-	7
	Theme two total credit	9											

Theme three share = 27 items from total	Cereals and Pulses Processing Technology	3	$3/12 = 0.25$	$0.25 * 26.67 = 7$	1	2	1	2	-	-	1	-	7
	Beverage Processing Technology	3	$3/12 = 0.25$	$0.25 * 26.67 = 7$	2	2	1	2	-	-	-	-	7
	Sugar and Coffee Processing Technology	3	$3/12 = 0.25$	$0.25 * 26.67 = 7$	2	1	1	2	-	-	1	-	7
	Fruits and Vegetable Processing Technology	3	$3/12 = 0.25$	$0.25 * 26.67 = 6$	1	2	1	2	-	-	-	-	6
	Theme three total credit	12											
Theme four share = 20 items from total	Dairy Processing Technology	3	$3/9 = 0.33$	$0.33 * 20 = 7$	2	2	1	1	-	-	1	-	7
	Fat and Oil Processing Technology	3	$3/9 = 0.33$	$0.33 * 20 = 6$	2	2	1	1	-	-	-	-	6
	Meat, Poultry and Fish Processing Technology	3	$3/9 = 0.33$	$0.33 * 20 = 7$	2	1	1	2	-	-	1	-	7
	Theme four total credit	9											

Theme five share = 20 items from total	Food Quality and Safety Management	3	$3/9 = 0.33$	$0.33*20 = 7$	2	2	1	2	-	-	-	-	7
	Food Packaging Technology	3	$3/9 = 0.33$	$0.33*20 = 7$	2	2	1	1	-	1	-	-	7
	Human Nutrition and Food Fortification	3	$3/9 = 0.33$	$0.33*20 = 6$	1	2	2	1	-	-	-	-	6
	Theme five total credit	9											
Total Cr hrs of the identified courses		45			22	28	17	26	3	4	5		100

NB: The detail of learning outcomes are stated on the table 3

9. LEARNING OUTCOMES IN TERMS OF THE THREE DOMAINS (COGNITIVE, AFFECTIVE AND PSYCHOMOTOR)

Table 3: Test blueprint

Themes	Course Name	Credit hour	Share of a themes in %	General objective	Specific objectives	Learning outcomes								No. of items
						Cognitive						Affective	Psychomotor	
						Remember	Understand	Apply	Analyse	Execute	Create			
Theme one	Food Chemistry	3	13	Enabling students to understand the different components of foods and the effects of processing conditions on reactivity of food component	➤ To apply the different chemistry concepts in food product development	1	-	1	-	-	-	-	-	2
					➤ Understand the chemistry of macro and micro nutrients in foods.	-	1	-	-	-	-	-	-	1
					➤ Comprehend nutrients interaction, enzymatic and Millard reaction	1	-	-	1	-	-	-	-	2
					➤ Understand and apply how processing conditions are likely to change the reactivity of food components.	-	1	-	-	-	-	-	-	1

			20													
Theme two	Fundamentals of Biochemical Engineering	3	20	To understand the basic concept biologically (enzymatically)	➤ Provide students with knowledge of how enzymes produce the components of our foods, enzyme kinetics emphasising on enzyme reaction and inhibition.	-	1	-	-	-	-	-	-	-	-	1
				induced reaction and the scale up of bioreactors and developed the skill on the bioreactors' design using enzymatic kinetics	➤ give students with knowledge of cell growth kinetics, fermenter design, Bioprocess scale up and skill of fermentation process control	-	-	-	1	2	-	-	-	3		
					➤ Improve student's knowledge and skill on the recovery mechanism of bio-processed products	-	1	1	-	-	-	-	-	2		
Mechanical Unit Operation	3	Understanding working principle of different food processing unit operations and develop skills in solving		➤ Understand and develop skills in the functions, working principles, and solutions to different unit operations.	-	1	-	-	-	-	-	-	-	1		
				➤ Know the principles of physical screening in raw material	1	-	-	-	-	-	-	-	1			

				different food unit operation problems	cleaning, size reduction and agglomeration.										
					➤ Understand fluidization, sedimentation principles, separation and mixing operations.										
						-	1	-	-	-	-	-	-	-	1
					➤ Know the mechanisms in handling and transportation of solid food materials.	-	-	1	1	-	-	-	-	-	2
					➤ know the bases for designing and selection of the appropriate mechanical unit operations in different food processing areas	-	-	-	1	-	1	-	-	-	2
	Engineering Properties of Food Materials	3		To understand and identify different kinds of food properties and apply the knowledge in process design	➤ To identify and apply the rheology and electromagnetic properties for different food products.	1	-	-	1	-	-	-	-	-	2
					➤ To understand the moisture content and water activity of food materials.	-	1	-	-	-	-	-	-	-	1

				equipment like hopper, cyclone, etc	➤ Apply the principles and applications of physical, geometric, electrical, magnetic and sound properties of foods on food processing	-	1	1	-	-	-	-	-	2
					➤ Apply their knowledge and skill in process design equipment, small scale processing plant and quality measuring tools							-	-	
						-	-	-	1	-	1	-	-	2
Theme three	Cereals and Pulses Processing Technology	3	27	To understand the quality parameters cereal grains and legumes and production of different extruded products along with its characterization.	➤ Understand the science and technology involved in the conversion of cereal grains and legumes into various products and by-products	-	2	-	-	-	-	-	-	2
					➤ Identify the different cereal grains produced and used worldwide for the production of human foods	1	-	-	-	-	-	-	-	1
					➤ Distinguish the grain varieties based on botanic aspects and their components;	-	-	1	-	-	-	-	-	1

					➤ Choose methods of analysis to evaluate the quality of grain and flour;	-	-	-	1	-	-	1	-	2
					➤ Evaluate the biochemical, chemical and technological interactions in the bread preparation;	-	-	-	1	-	-	-	-	1
	Beverage Processing Technology	3		To gain knowledge on different products of alcoholic and non-alcoholic beverages and acquire skills on the up grading the indigenous beverages on to large scale	➤ Acquire knowledge and skill on the handling and preparation of raw materials used for the production of different beverages	1		-	-	-	-	-	-	1
					➤ Differentiate alcoholic and non-alcoholic beverages	1			1			-	-	2
					➤ Understand the knowledge and skills on malt production and quality evolution to meet to the purpose of brewing industry	-	1	-	-	-	-	-	-	1
					➤ Understand and apply the scaling up of the indigenous technologies on alcoholic and non-alcoholic beverages	-	1	-	-	-	-	-	-	1

					➤ Determine the appropriate handling, storage and transportation of different types of processed beverages.	-	-	1	1	-	-	-	-	2
	Sugar and Coffee Processing Technology	3		To understand the basic concept of sugar production and sugar by-products utilizing and coffee anatomy and its quality standard	➤ Understand production of sugar from different raw materials and converting its by-products into different usable products	-	1	-	-	-	-	-	-	1
					➤ Composition, quality analysis involved in the extraction of sugar,	-	-	-	1	-	-	-	-	1
					➤ Apply the knowledge in the sugar processing industry and sugar by-products utilizing industries	-	-	1	-	-	-	-	-	1
					➤ Differentiate the anatomy and physiology of the coffee fruits and the postharvest changes.	-	-	1	1	-	-	-	-	2

					➤ Be familiar with the quality standards expected from export grade coffee beans and the care required for maintaining the quality during processing, storage and transportation. .	1	1	-	-	-	-	-	-	2
	Fruits and Vegetable Processing Technology	3	,	To know the conversion of fruits and vegetables into various shelf-stable, value added, safe and nutritious foods and beverages and characterize its quality parameters	➤ Execute duties regarding classification of fruits based on their characteristics, processing properties, origins and changes during maturation, maturity indices and formulate products from fruits and vegetables	1	-	-	-	-	-	-	-	1

					➤ Understand the physiology and different processing technology of various types of fruits and vegetables into various shelf-stable, value added, safe and nutritious foods and beverages.	-	2	-	-	-	-	-	-	2
					➤ To study the various quality analysis and descriptions associated to fruits and vegetables and their products.	-	-	-	2	-	-	-	-	2
					➤ Apply heat and different chemicals for fruits and vegetables processing and preservation	-	-	1	-	-	-	-	-	1
					➤ Explain processes involved in production of milk and milk products.	2	-	-	-	-	-	-	-	2
					➤ Understand the milk composition, physicochemical properties and factors affecting it.	-	1	-	-	-	-	-	-	1
					➤ Describe the function and criteria of a good starter culture	-	1	-	-	-	-	-	-	1
Theme four	Dairy Processing Technology	3	20	To get knowledge of processes involved in production of milk, and milk products and understand milk composition along with its analysis										

					➤ Gain insight in the production of different milk derived products	-	-	-	-	-	-	1	-	1
					➤ Perform chemical analyses on dairy products	-	1		1	-	-	-	-	2
	Fat and Oil Processing Technology	3		To understand the production of fats and oil from different raw food materials and determine its quality	➤ Ability to produce and analysis the physiochemical properties of edible oil from different raw materials	-	-	-	1	-	-	-	-	1
					➤ Know lipid deterioration mechanism	-	2	-	-	-	-	-	2	
					➤ Identify the modified functionalities of the oil and to apply the knowledge in the oil seeds processing (edible oil extraction technologies, refining operations and quality evaluations)	1	-	-	-	-	-	-	1	
					➤ Develop the competencies of applying the technology of the conversion of edible oils into various products (edible refined oils, shortenings, margarine)	1	-	1	-	-	-	-	2	

	Meat, Poultry and Fish Processing Technology	3		To enable students understand the production process of meat, poultry and fish and characterize the quality of their products	➤ Understanding production process and characterization of different meat products	1	-	-	-	-	-	-	-	1
					➤ Understand and describe the structure and composition of muscle, connective tissue, and fat in meat, poultry and fish.	-	1	-	-	-	-	-	-	1
					➤ Identify the factors determining meat quality and explores ways for reliable and measurable indicators of quality attributes and then develop various nutritionally important meat products	1	-	-	1	-	-	-	-	2
					➤ Describe good manufacturing practice, microbiology and public health issues associated with meat, poultry and fish products	-	-	1	1	-	-	1	-	3
Theme five	Food Quality and Safety Management	3	20	To understand the food quality monitoring system and analysis its role, and implementation in processing.	➤ Application of a food quality and safety like GMP and HACCP system.	-	-	1	-	-	-	-	-	1
					➤ Elaborate the concepts of food quality and safety management, its role and implementation in processing.	1	1	-	-	-	-	-	-	2

					➤ Analyse problems on food safety issues including recommendations for correcting actions and communications to decision makers	-	-	-	2	-	-	-	-	2
					➤ Demonstrate detailed knowledge of the international standards, food laws and regulations with respect to national context, and their applications by national authorities	1	1	-	-	-	-	-	-	2
	Food Packaging Technology	3		Enabling students to understand the properties different types of food packaging and identify the compatible packaging materials to different food items	➤ Work on packaging innovation and technology	-	-	1	-	-	-	-	-	1
					➤ Understand the composition, microstructure and properties of food packaging materials and its effect on the food and the environment	-	1	-	-	-	-	-	-	1
					➤ Explain the scientific and technological principles of different packaging materials and know the advantages and weakness of various food packaging materials.	2	-	-	1	-	-	-	-	3

					➤ Understand the basic principles of novel packaging design and the quality and shelf life of packaged foods	-	1	-	-	-	1	-	-	2
	Human Nutrition and Food Fortification	3		To identify the sources and types of malnutrition and address it through fortifying different food items	➤ Develop and asses different new food products through Fortification	-	-	2	1	-	-	-	-	3
					➤ Understand how foods are fortified for improvement of vitamins, minerals, essential amino acids and essential fatty acids	-	1	-	-	-	-	-	1	
					➤ Understand how functional foods are processed: source, formulations, possessing, marketing	-	1	-	-	-	-	-	1	
					➤ Understand the benefits (nutrition and health) of both fortified and functional foods	1	-	-	-	-	-	-	1	
Total						21	29	16	24	4	3	3	21	100

10. APPENDIX

Table 4: Name of department/ program in different Universities

<i>S/N</i>	<i>Name of Department/ Program</i>	<i>Universities</i>
1	<i>Food Engineering</i>	<i>Bahir Dar University and Gambela University, Debr-Berhan University and Dilla University</i>
2	<i>Food Technology and Process Engineering</i>	<i>Haramaya University, Oda Bultum University Wallaga University and Arba Minch University</i>
3	<i>Food Process Engineering and Postharvest Technology</i>	<i>Ambo University</i>
4	<i>Food Process Engineering</i>	<i>Welkite University</i>

Note: *The course name and contents are similar across the university but the program name is different from university to university*