



## **Ministry of Education**

### **Identified Competency Focus Areas and Selected Courses for Ethiopian Higher Education Institutions' Exit Examination**

#### **Program:**

#### **Bachelor of Science in Food Engineering**

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# **1. Introduction**

## **1.1 Background**

Now a day, food processing industries get great recognition in Ethiopia as a high-priority area. In order to achieve the expected returns on investment through good quality and right value addition, application of technology and Engineering has become imperative, leading to an unprecedented demand for scientists, technologists, Engineers and other professionals who can manage the emerging challenges of the food processing industry effectively. The importance of Food Engineering program has to be greatly enhanced in scenario of the country today.

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 (including food engineering) use and manipulate mathematics, physics, and engineering art to solve technical problems in a safe and economical fashion. In addition, Food engineering includes the vast application of other disciplines such as food chemistry, physics, 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.

## **1.2 Objectives of the Exit Examination**

The national public administration exit exam shall have the following objectives

- ✓ To produce skilled and competent manpower to national and international market
- ✓ Assessing students' educational achievement in major areas of public administration and development management (PADM)
- ✓ Ensuring whether the graduation profile of PADM curriculum have achieved at least common standards of knowledge and practical skills

- ✓ Improving public trust and confidence in public administration activities of professionals
- ✓ Facilitating the efforts of students to revise the core learning outcomes of the courses covered by the exit examination
- ✓ Ensuring all graduates from HEIs satisfy the requirements of the labor market and employability through the national wide implementation of competency-based exit exam
- ✓ Creating competitive spirit among PADM departments in Ethiopia with the view to encouraging them to give due attention to the national standards

### **1.3 Significance of the Document**

It is important to set competency areas of the subject matter (program) in order to measure the how much graduates are acquired with skills, knowledge and attitudes. The following shows us the significance or setting competencies and identifying core courses of the program;

- ✓ To set competencies that helps to assess the basic skills, knowledge and attitude of graduating students
- ✓ To systematically identify the core courses which will be included the exit exam

## **2. Expected Profile of Graduate**

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

### **2.1 Engineering 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

### **2.2 Skills/ Career Prospects:**

- 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 skills

- 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

Courses and Competencies Identified for Exit Exam 2015 (First Draft)

### 3. Competencies and Learning Outcomes

#### 3.1 Competencies

The Food Engineering programs competencies are established based on program educational Objectives. All graduates of Food Engineering undergraduate program are expected to have the following competencies:

- Modify existing products and processes and develop new ones
- Check and improve safety and quality control procedures in your own and suppliers' factories, from the raw material stage through to the finished product
- Research current consumer markets and latest technologies to develop new product concepts
- Select raw materials and other ingredients from suppliers
- Prepare product costing based on raw materials and manufacturing costs to ensure profitable products
- Audit suppliers or manage internal audits
- Run trials of new products - either alongside or together with product development
- Coordinate launches of new products
- 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
- Build relationships with suppliers and customers
- 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

### 3.2 Learning Outcomes

- 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.

#### **4. Course to Be Included For Exit Examination**

Even though under Food engineering (BSc) program sixty six (66) course are delivered for the sake of national exit exam the following core courses are identified ,which are very important in order to achieve the above mentioned expected out come and competence of Food Engineer professional .

1. Food Chemistry
2. Food Analysis
3. Fundamentals of Biochemical Engineering
4. Mechanical Unit Operation
5. Engineering Properties of Food Materials
6. Grain (Cereal) Processing Technology
7. Beverage Processing Technology
8. Sugar and Coffee Processing Technology
9. Fruits and Vegetable Processing Technology
10. Dairy Processing Technology
11. Fat and Oil Processing Technology
12. Meat, Poultry and Fish Processing Technology
13. Food Quality and Safety Management
14. Food Packaging Technology
15. Human Nutrition and Food Fortification

## **5. Categories of Courses in Thematic Areas**

The following thematic area of the course is selected by considering the harmonized curriculum which enables to achieve the mentioned competencies.

### **5.1 Applied Sciences for Food Engineering**

- ✓ Food Chemistry
- ✓ Food Analysis

### **5.2 Bioprocess and Basics of Food Engineering**

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

### **5.3 Plant Based Food Processing Technology**

- ✓ Grain Processing Technology
- ✓ Beverage Processing Technology
- ✓ Sugar and Coffee Processing Technology
- ✓ Fruits and Vegetable Processing Technology

### **5.4 Animal Based Food Processing Technology**

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

### **5.5 Food Packaging, Quality and Safety**

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

**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             | <ul style="list-style-type: none"> <li>✓ Food Chemistry</li> <li>✓ Food Analysis</li> </ul>                                                                                                                                       | 5<br>4           | 3<br>3           |        |
| 2   | Bioprocess and Basics of Food Engineering | 3             | <ul style="list-style-type: none"> <li>✓ Fundamentals of Biochemical Engineering</li> <li>✓ Mechanical Unit Operation</li> <li>✓ Engineering Properties of Food Materials</li> </ul>                                              | 5<br>5<br>4      | 3<br>3<br>3      |        |
| 3   | Plant Based Food Processing Technology    | 4             | <ul style="list-style-type: none"> <li>✓ Grain Processing Technology</li> <li>✓ Beverage Processing Technology</li> <li>✓ Sugar and Coffee Processing Technology</li> <li>✓ Fruits and Vegetable Processing Technology</li> </ul> | 5<br>5<br>5<br>5 | 3<br>3<br>3<br>3 |        |
| 4   | Animal Based Food Processing Technology   | 3             | <ul style="list-style-type: none"> <li>✓ Dairy Processing Technology</li> <li>✓ Fat and oil Processing Technology</li> <li>✓ Meat, Poultry and Fish Processing Technology</li> </ul>                                              | 4<br>4<br>5      | 3<br>3<br>3      |        |
| 5   | Food Packaging, Quality and Safety        | 2             | <ul style="list-style-type: none"> <li>✓ Food Quality and Safety Management</li> <li>✓ Food Packaging Technology</li> <li>✓ Human Nutrition and Food Fortification</li> </ul>                                                     | 3<br>3<br>4      | 2<br>3<br>3      |        |

## 6. Conclusion

As a conclusion, Food Engineering national exit exam will enhance quality of the graduates in different aspects like skill, knowledge and attitude. This document is highly devoted to present the major and comprehensive relevant courses to carry out the national exit exam of Food Engineering graduates. The exit exam questions are highly focused on the long-term knowledge and transferred skill rather than more specific and subjective cases. Based on direction given by Ministry of Education (MoE), the exit exam course should be between 10-15 courses. Thus, fifteen (15) courses were selected and categorized under five (5) thematic areas. The exam will be delivered before graduation (probably in the month of July). The courses were selected based on the food discipline which involves science, technology and Engineering knowledge to the foods from harvest to the consumption, mainly to convert agricultural produces into value-added, nutritious, shelf-stable and safe food products. The commencement of the exit exam will be on 2015 E.C graduates.

Courses and Competencies Identified for Exit Exam 2015 (First Draft)

## 7. APPENDIX

| Module No | Module Name                        | Course Name                              | Course Code | ECTS | Cr. Hr |
|-----------|------------------------------------|------------------------------------------|-------------|------|--------|
| 01        | Humanities and Social Science      | Communicative English Language Skill I   | FLEn1011    | 5    | 3      |
|           |                                    | Communicative English Language Skill II  | FLEn1012    | 5    | 3      |
|           |                                    | Critical Thinking                        | LoCT1011    | 5    | 3      |
|           |                                    | Moral and Civic Education                | MciE1012    | 4    | 2      |
|           |                                    | Geography of Ethiopia and the Horn       | GeES1011    | 5    | 3      |
|           |                                    | General Psychology                       | Psch1011    | 5    | 3      |
|           |                                    | Social Anthropology                      | Anth1012    | 4    | 2      |
|           |                                    | Global Trends                            | GlTr2011    | 4    | 2      |
|           |                                    | Inclusiveness                            | Incl2011    | 4    | 2      |
|           |                                    | Physical Fitness                         | SpSc1011    | P/F  | 1      |
|           | Management and Entrepreneurship    | Introduction to Economics                | Econ2021    | 5    | 2      |
|           |                                    | Industrial Management                    | MgMt5022    | 3    | 3      |
|           |                                    | Entrepreneurship                         | MgMt1022    | 5    | 3      |
| 03        | General Engineering                | General physics                          | Phys1031    | 5    | 2      |
|           |                                    | Engineering Drawing                      | MEng2031    | 5    | 3      |
|           |                                    | Computer Programming                     | ECEg1032    | 5    | 3      |
|           |                                    | Introduction to Emerging Technology      | EmTe1032    | 5    | 3      |
|           |                                    | Engineering Mechanics I (statics)        | CEng2031    | 5    | 3      |
| 04        | Applied Mathematics and statistics | Mathematics for Natural Sciences         | Math1041    | 5    | 3      |
|           |                                    | Applied Mathematics I                    | Math1042    | 5    | 3      |
|           |                                    | Applied Mathematics II                   | Math2041    | 5    | 3      |
|           |                                    | Applied Mathematics III                  | Math2042    | 6    | 3      |
|           |                                    | Probability and Statistics for Engineers | Stat2041    | 5    | 2      |
|           |                                    |                                          |             |      |        |

|    |                                        |                                                   |          |   |   |
|----|----------------------------------------|---------------------------------------------------|----------|---|---|
| 05 | Applied Sciences for Food Engineering  | Food Chemistry                                    | FEng2052 | 5 | 3 |
|    |                                        | Food Analysis                                     | FEng3051 | 4 | 2 |
|    |                                        | Food Microbiology                                 | FEng2054 | 5 | 3 |
| 06 | Unit Operations in Food Processing     | Mechanical Unit Operation                         | FEng3061 | 5 | 3 |
|    |                                        | Heat transfer unit operation                      | FEng3062 | 5 | 3 |
|    |                                        | Mass transfer unit operation                      | Feng4061 | 5 | 3 |
| 07 | Food Machinery and Instrumentation     | Fundamental of Electrical Machine and Electronics | EEng3071 | 4 | 2 |
|    |                                        | Food Engineering Drawing                          | FEng2072 | 3 | 2 |
|    |                                        | Food Machinery and Equipment Design               | FEng3072 | 4 | 2 |
|    |                                        | Process Control and Instrumentation               | FEng3074 | 5 | 3 |
|    |                                        | Fluid Mechanics and Rheology                      | FEng3082 | 5 | 3 |
|    |                                        | Applied Thermodynamics                            | FEng3081 | 5 | 3 |
| 08 | Basics of Food Engineering             | Transport Phenomena                               | FEng2082 | 5 | 3 |
|    |                                        | Engineering Properties of Food Materials          | FEng2084 | 4 | 2 |
|    |                                        | Fundamentals of Food process                      | FEng2086 | 5 | 3 |
| 09 | Plant based Food Processing Technology | Grain Processing Technology                       | FEng3091 | 5 | 3 |
|    |                                        | Beverage Processing Technology                    | FEng4091 | 5 | 3 |
|    |                                        | Sugar & Confectionary Processing Technology       | FEng4093 | 5 | 3 |
|    |                                        | Coffee, Tea and Spice Processing Technology       | FEng5092 | 4 | 2 |
|    |                                        | Fruit & Vegetable Processing Technology           | FEng3092 | 5 | 3 |
|    |                                        | Fat and oil Processing Technology                 | FEng3094 | 4 | 2 |
|    |                                        |                                                   |          |   |   |
|    |                                        |                                                   |          |   |   |
|    |                                        |                                                   |          |   |   |

|    |                                           |                                                        |           |     |   |
|----|-------------------------------------------|--------------------------------------------------------|-----------|-----|---|
| 10 | Animal based Food Processing Technology   | Dairy Processing Technology                            | FEEng3102 | 4   | 2 |
|    |                                           | Meat, Poultry and Fish Processing Technology           | FEEng3101 | 5   | 3 |
| 11 | Reaction and Bioprocess Engineering       | Food Biotechnology                                     | FEEng3111 | 5   | 3 |
|    |                                           | Fundamentals of Reaction Kinetics and Reactor Design   | FEEng4111 | 5   | 3 |
|    |                                           | Biochemical Engineering                                | FEEng4112 | 5   | 3 |
| 12 | Computational Methods in Food Engineering | Numerical Methods                                      | FEEng4121 | 5   | 3 |
|    |                                           | Computer Aided Food Process Design and Simulation      | FEEng5122 | 5   | 3 |
| 13 | Plant Design                              | Food Plant Design and Economics                        | FEEng4132 | 5   | 3 |
|    |                                           | Food Plant Sanitation and Waste Treatment              | FEEng4134 | 4   | 2 |
| 14 | Food Quality and Safety                   | Food Quality and Safety Management                     | FEEng4142 | 3   | 2 |
|    |                                           | Food Toxicology                                        | FEEng5142 | 3   | 3 |
| 15 | Food Product Design                       | Food product development & sensory science             | FEEng4151 | 5   | 3 |
|    |                                           | Fundamentals of Human Nutrition and Food Fortification | FEEng4153 | 4   | 2 |
|    |                                           | Food Packaging Technology                              | FEEng4152 | 3   | 3 |
| 16 | Holistic Exam and Industrial              | Holistic Examination                                   | FEEng5161 | P/F | 0 |
|    |                                           | Internship                                             | FEEng5163 | 30  | 0 |
| 17 | Research and Project                      | Research Methodology and Experimental                  | FEEng4172 | 4   | 3 |
|    |                                           | Semester Project                                       | FEEng4174 | 5   | 3 |
|    |                                           | Final Year Project                                     | FEEng5172 | 10  | 1 |