

**Ministry of Education**

**Identified Competency Focus Areas and Core Courses for Ethiopian Higher Education Institutions’ Exit Examination**

Program: - Bachelor of Science in Biotechnology

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**Contents page**

[1, Introduction 3](#_Toc109119207)

[2, Expected profiles of graduates 4](#_Toc109119208)

[3, Competences and learning outcomes 5](#_Toc109119209)

[4, Courses to be included in the exam 5](#_Toc109119210)

[4.1, List thematize areas with course 6](#_Toc109119211)

[5, Categorizing courses in to sub-themes 7](#_Toc109119212)

[6, Conclusion 9](#_Toc109119213)

# **1, Introduction**

Biotechnology is a rapidly growing and a cross-cutting field that uses a combination of biology and technology to develop technologies and products which help to improve our health, agriculture, industry and environmental management. Biotechnology helps to design and produce new molecules, plants, animals and microorganisms with improved characteristics. It offers seemingly unlimited opportunities to combine genes from related or unrelated species to produce useful organisms with desirable properties that were not previously found in nature. To realize the full potential of this field as a frontline area of research and development with an overwhelming impact on the societal and national economic development, higher education institutions of Ethiopia are expected to produce competent professionals that can make the country beneficiary of the modern applications in the discipline. Therein, biotechnology program was launched in various public universities of Ethiopia, aims to produce competent graduates with the appropriate knowledge and skills.

The BSc. program in Biotechnology requires four years of studies, of which the first year is designed for national common course work and the rest for major and supplementary courses. The curriculum, in addition to offering basic theoretical knowledge, practical core set of skills and techniques in biotechnology, and entrepreneurial skills, is designed to include fundamental concepts that span across other basic life and social sciences, chemistry, physics, and mathematics. For this, students are expected to take 53 coursers with minimum 151 credit hours. Post completions of the B.Sc. program, the students are envisaged to acquire a comprehensive understanding on the core concepts and applied aspects of the constantly growing niche of modern biotechnology and its allied wings. Thus, it is necessary to measure the achievement of these objectives through exit exams. Additionally, the implementation of exit examination is related to the regulation and improvement of the quality of higher education.

University Exit Exam is a standardized comprehensive curriculum-based test which is designed to assess if students have achieved the minimum competence that was stipulated in the graduates’ profile. Thus, the ministry of education (MOE) has planned to deliver exit exams for several undergraduate programs, including biotechnology. For successful implementation of the exit exam, it is necessary to identify the key graduate profiles and the core competences of the curriculum. Moreover, student attainment of learning outcomes should be also assessed through standardized exams which set to measure the knowledge (**K**), attitude (**A**) and skill(**S**) of graduates. As a result, it is necessary to select core biotechnology courses which are necessary to prepare in exit exam as measure of attainment of core competences of the biotechnology program. It should be also noted exam from these courses should focus on attainment of core subject competences rather than just measuring remembrances.

# **2, Expected profiles of graduates**

The graduates of Biotechnology program will be expected to:

* Work at governmental, non-governmental or private institutions in agricultural, medical, industrial, environmental protection as researchers and graduate assistants, laboratory technicians, service providers, and development workers;
* Have basic understanding of technical and scientific tools of Biotechnology
* Be aware of and adopt current advances of technology in life science.
* Identify problems; design and execute research projects in biotechnology and related areas.
* Follow and adapt standard procedures to carry out qualitative and quantitative analysis in Biotechnology laboratories;
* Assist regulatory bodies in using and managing Biotechnology products;
* Apply basic biotechnological principles for innovation;
* Capable of understanding current issues and debates in Biotechnology and biosafety at national and international levels;
* Pursue further specialized educations in various fields of Biotechnology and related fields.
* Write scientific papers in order to disseminate scientific knowledge of biotechnology
* Be entrepreneurs who will invest their knowledge in different sectors life sciences

# **3, Competences and learning outcomes**

The competency and learning outcome achieved at the end of four-year study of the biotechnology program includes.

* ability to identify, formulate, and solve broadly defined technical or scientific problems by applying principles and practices of biotechnology, sciences, and mathematics.
* an ability to formulate or design a system, process, procedure or program to meet desired needs of biotechnological applications in agriculture, industry, environment and health development.
* an ability to develop and conduct appropriate experimentation, analyze and interpret data and use scientific judgment to draw conclusions.
* an ability to understand ethical and professional responsibilities and make informed judgment, which must consider the impact of biotechnological solutions in global, economic, environmental, and societal contexts.
* an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, meet objectives and deadlines, and analyze risk and uncertainty.
* an ability to develop an entrepreneurial mindset and understand the dynamics of bioscience industry to translate scientific innovations into bio-based products, processes, services and viable business opportunities
* an ability to acquire and apply new knowledge and technologies in the bioeconomy development.

# **4, Courses to be included in the exam**

Biotechnology represents a nexus of interdisciplinary realms. The students shall trace their journey from the basics of biochemistry, cell biology, molecular biology and genetics towards understanding the current endeavors to unmask the intricate networks of the molecular building blocks of life and engineer biomolecules and nucleic acid through courses on omics science, bioinformatics, Genetic engineering and others. Likewise, course-content on the basics and advanced developments in the realms of microbial, plant and animal biotechnology would be complementing the various topics of tissue culture, molecular markers, industrial biotechnology, food biotechnology, enzyme technology as well as environmental biotechnology. In a similar vein, courses like diagnostic technology, immune-technology and medical biotechnology would open the portal towards the various advancements in the domain of health biotechnology. Besides being cognizant about the fields of aquatic biotechnology, forensic biotechnology as well as fungal biotechnology, the students would learn the various issues of intellectual property rights and biosafety. Overall, many of these courses are included in harmonized BSC curriculum delivered in several higher institutions as well as in Addis Abba science and technology curriculum designed for accreditations. Hence, 16courses for exit exam preparation are uniquely selected from basic biotechnology areas as well as from major application areas of the discipline for measuring the competences the graduate nationally and internationally.

## **4.1 List of thematized areas in the program**

1. **Industrial and microbial biotechnology**

* Microbial Biotechnology
* Fungal Biotechnology
* Industrial Biotechnology
* Enzyme Technology

1. **Agricultural biotechnology**

* Plant Biotechnology
* Animal Biotechnology
* Plant Cell and Tissue Culture

1. **Basic biotechnology**

* Molecular biology
* Techniques in Molecular biology
* Biochemistry

1. **Health biotechnology**

* Medical Biotechnology
* Immunology and Immune- technology

1. **Environmental biotechnology**

* Environmental Biotechnology
* Biosafety and Intellectual Property Right in Biotechnology

1. **Genomics and bioinformatics**

* Genetic Engineering
* Bioinformatics

# **5, Categorizing courses in to sub-themes**

The table blow shows coursers selected for exit exam preparation along with their categories. The numbers of course selected from each category is based on the coverage of each stream/area in curriculum and also expected graduate profile.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. N** | **Areas/Streams** | **ECTS** | **%ECTS** | **Number of Selected**  **Courses (out of 15)** | **Selected Courses** | **Cr. Hrs.** | **K** | **A** | **S** |
| 1 | Microbial and  industrial Biotechnology | 27 | 25 | 3.75 | Microbial Biotechnology | (2+1) | √ |  | √ |
| Fungal Biotechnology | (1+1) | √ |  | √ |
| Industrial Biotechnology | (2+1) | √ | √ | √ |
| Enzyme Technology | (2+1) | √ |  | √ |
| 2 | Agricultural  Biotechnology | 21 | 19.2 | 2.88 | Plant Biotechnology | (2+0) | √ |  |  |
| Animal Biotechnology | (3+1) | √ | √ | √ |
| Plant Cell and Tissue Culture | (1+1 /0+2) | √ | √ | √ |
| 3 | Basic  Biotechnology | 18 | 16.5 | 2.4 | Molecular biology | (2+0/3+0) | √ |  |  |
| Techniques in Molecular biology | (0+1/0+2) |  | √ | √ |
| Biochemistry | (3+1/ 2+1 | √ |  | √ |
| 4 | Medical  Biotechnology | 16 | 14.7 | 2.19 | Medical Biotechnology | (2+1 /3+0) | √ |  | √ |
| Immunology and Immune-technology | (2+1) | √ | √ | √ |
| 5 | Environmental  Biotechnology | 14 | 12.8 | 1.92 | Environmental Biotechnology | (2+1/ 3+0) | √ | √ | √ |
| Biosafety and Intellectual Property Right in Biotechnology | (2+0) | √ | √ |  |
| 6 | Genomics Science  and Bioinformatics | 13 | 11.9 | 1.78 | Genetic Engineering | (2+1) | √ |  | √ |
| Bioinformatics | (2+1) | √ |  | √ |

# **6, Conclusion**

Providing quality education is a major goal of higher education’s institution. To achieve this, it is necessary to track and evaluate student knowledge, attitude and skill through Exit Exam by focusing on core competency and graduate profiles. Though 53 courses are delivered in BSC curriculum, 10-15 courses have to be selected for exit exam preparation as per MOE and thereby 16 courses are selected from major application areas of biotechnology. In preparation of exams

* Exam should be prepared in manner to measure the attainment of program learning outcomes by specially focusing on core competency of each subject
* Since many of selected courses includes practical sessions, exam should address the skills obtained
* Timing of exam should be properly planned to avoid burden of completion of second semester courses of graduates.
* Exit exam should include all Contents of each course to bring computable learning out comes.
* Selected courses for exit exam are not enough to measure learner competency.
* providing students with quality education has become the main concern for most universities. Exit Exam is one of direct tool to assess programming learning outcomes and Universities design Exit Exams to measure students’ comprehensive understanding of their majors, as well as preparing them to be engaged in work.
* Exit exams have been argued to improve the signaling of educational achievement on the labor market and to increase labor-market productivity through increased human capital.
* The exit exam is intended to ensure all graduates from HEIs have developed adequate mastery of the core competencies articulated in the respective curricula thereby satisfying the requirements of the labor market and employability through the nationwide implementation of curriculum-based external exit examination.
* learning competencies requires the introduction of nationwide quality indicators for placement and exit tests administered in the Ethiopian Higher Education system
* Overall processes exit exam require the allocation of quite a significant amount of time, money, and personnel