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**Ministry of Education**

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

Program: - Bachelor of Science (Education) in Mathematics

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7. **Introduction**

Mathematics program is a fundamental field of study that plays a big role in the development of science, technology, business, computer science and other fields. The program is designed to enable the graduates to acquire fundamental knowledge, skill and desired attitude so that they will be competent to work in the industry or to teach at secondary school level. The general objective of this program is to train qualified, adaptable, motivated, and responsible Mathematicians who will contribute to the scientific and technological development of Ethiopia. And specific objectives are;

* Provide an in-depth understanding of the fundamental principles and techniques of Mathematics.
* Develop mathematical concepts and definitions, and to extend and generalize them to new situations.
* Progress Mathematical thinking, reasoning and an appreciation of Mathematics as a primary language of science.
* Make students understand the connections between mathematics and other disciplines, and being able to recognize mathematical ideas embedded in other contexts.
* Develop the fundamental concepts of mathematical modeling and how to apply mathematics to real-world situations.

Thus, to attain those objectives it is essential that students be equipped with strong mathematics knowledge and skills which enable them to be productive. Meanwhile, it is important to check also whether graduates gained the needed knowledge and skills to fit with the desired market.

 Nowadays, the Ethiopian government is giving much more emphasis to quality of education and competence of graduates in Higher Education Institutions (HEI), which needed to prepare exit exam for programs at national level. Exit exam measures the learning outputs of a program and it will help the institutions to work towards quality and competence of their graduates. In addition, exit exam has the following importance;

* It assesses the basic skills and knowledge of students.
* It assesses students’ overall understanding of their educational experience.
* It helps institutions to produce skilled and competent manpower for the market.
* It ensures that first-degree graduates met the graduate profile.
* It improves the learning outcomes of students and their subsequent labor market performance.
* It improves quality of education.
* It can be used as source of information for policy decisions at national level.

This document is prepared to set competencies and identify courses to be included in the exit exam for mathematics program. The courses are selected from among the major or compulsory courses based on the curriculum of BED and BSc.

1. **Expected Profile of Graduates**

A graduate of the program will be able to:

* Acquire fundamental knowledge of mathematics to teach in secondary schools.
* Develop mathematical skills needed in modeling and solving practical problems.
* Apply mathematics to solve real world problems in various application areas such as in industries, economics and health science.
* Develop the knowledge, skills and attitudes necessary to pursue further studies in mathematics and related fields of study.
* Create job opportunities by applying the acquired knowledge and skills.
1. **Core Competencies and Learning Outcomes**
	1. **Core Competencies**

The core competencies of graduates of mathematics are;

* Able to set up mathematical models, formulate algorithm and implement them by using computational methods to real life problems.
* Act in an ethical manner, recognize and be guided by social, professional and ethical issues involved in his/her career in particular and in the community in general.
* Exercise the power to self-expression, develop abstract, logical and critical thinking, the ability to reflect critically upon their work, the work of others, and justify the degree of accuracy of their results where appropriate.
	1. **Learning Outcomes**

The learning outcomes of mathematics program are;

* A qualified graduate who has good knowledge of mathematics to teach at secondary school level or apply mathematics to solve real world problems and problems of his country.
* Responsible Mathematicians who will contribute to the scientific and technological development of Ethiopia.
* Graduates who can assist and participate in conducting scientific research.
* Graduates who can demonstrate environmental, social and cultural awareness.
* Mathematicians who will pursue graduate studies in mathematics and related fields of study.
* A qualified graduate who thinks critically and reason logically.
1. **Courses to be Included**

 Courses that will be included in the exit exam for mathematics program are identified based on the following;

* Relevance of the course to measure the three learning domains.
* Relevance of the course to measure the three competencies of graduates.
* Major (or compulsory) courses of the program both for teaching and applied.

The following courses are identified to be included in exit exam.

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Course Name | Course Cr. hrs | Description |
| 1 | Fundamental Concepts of Algebra | 3 | The course mainly covers relations, classification of sets, cardinal numbers, groups, rings, and the system of integers. |
| 2 | Calculus I | 4 | This course introduces the basic concepts of limit, continuity, differentiation, integration, and some of their applications. |
| 3 | Calculus II | 4 | This course covers inverse functions, derivatives of inverse functions, techniques of integration focusing on trigonometric substitution and partial fractions, Trapezoidal rule and Simpson’s rule, arc length, indeterminate forms, sequences, series and power series. |
| 4 | Linear Algebra I | 3 | This course covers vectors, lines and planes, vector spaces, matrices, system of linear equations, determinants, eigenvalues and eigenvectors, and linear transformations. |
| 5 | Number Theory | 3 | This course covers algebraic structure of integers, basic notions of divisibility theory, Diophantine equations, theory of congruence and equations over finite rings, decimal representations of rational numbers, continued fractions, and quadratic extension of rational numbers. |
| 6 | Numerical Analysis I | 3 | This course covers basic concepts in error estimation, solutions of non-linear equations, solutions of system of linear equations and non-linear equations, finite differences, numerical interpolations, numerical differentiation and numerical integration. |
| 7 | Linear Optimization | 3 | This course deals with linear programming, geometric and simplex methods, duality theory and further variations of the simplex method, sensitivity analysis, interior point methods, transportation problems, and theory of games. |
| 8 | Ordinary Differential Equation | 4 | This course covers basic definitions and terminology, preliminary theory of first and higher order linear ordinary differential equations (ODEs), method of solutions and their applications, series solution, Laplace transform, and systems of first order linear differential equations. |
| 9 | Calculus of Function of Complex Variables | 4 | The course mainly covers the complex number system, complex differentiability, analytic functions, conformal mappings, complex integration Cauchy's theorem, Cauchy integral formula, power series representations of analytic functions, Laurent series, residue theorem, evaluation of definite integrals, and Mobius transformation. |
| 10 | Partial Differential Equations | 3 | This course discusses basic concepts of partial differential equations (PDE), some techniques of solutions of first order PDE, Fourier series, second order PDE and analytical methods of solutions. |

 **Table 2**: Selected courses to be included in exit exam.

1. **Categorized Courses into Themes**

The selected courses in the above section can be categorized into the following four themes.

|  |  |  |
| --- | --- | --- |
| No. | Category Name | List of courses in the category |
| Theme I | Analysis | Calculus I |
| Calculus II |
| Calculus of Function of Complex Variables |
| Theme II | Numerical Analysis/ Optimization | Numerical Analysis I |
| Linear Optimization |
| Theme III | Differential Equations | Ordinary Differential Equations |
| Partial Differential Equations |
| Theme IV | Algebra | Fundamental Concepts of Algebra |
| Linear Algebra I |
| Number Theory |

Table 3: Categorized courses into themes.

1. **Conclusion**

In summary, courses to be included in the exit exam have been identified and competencies have been set for first degree mathematics program. Ten courses have been selected and the three courses namely, Transformation Geometry, Calculus of functions of several variables and Modern Algebra I are not included in selection, we think that basic skills obtained from these courses can be tested in the courses Calculus I, Calculus II, Linear Algebra I and Fundamental concepts of Algebra.