

**Ministry of Education**

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

Program: - Bachelor of Science in Computer Science

Animal Sciences Graduates To Be Held In 2015 E.C

Competencies & Courses Suggested For Exit Examination For Bsc In

Animal Sciences Graduates To Be Held In 2015 E.C

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# **Introduction**

We live in the digital age, where computers pervade every aspect of our daily lives. It is believed that the potential of computers and the benefits they can bring to society are only just beginning to be realized. Computer scientists are at the forefront of figuring this out, with the goal of improving existing solutions as well as developing entirely new ones. The development of theories, as well as the design and implementation of software and hardware solutions, all necessitate the involvement of computer scientists. As a result, universities both locally and globally teach computer science in an effort to produce the scientists and engineers of tomorrow.

Most Ethiopian higher education institutions offer computer science as a four-year degree program, with the goal of contributing to the country's overall growth by producing needed manpower. In line with this, to avoid irregularities on the graduation profile a harmonized curriculum is in practice which is implemented across all universities. The curriculum states that the minimum requirement for graduation is a CGPA of 2.0, which does not measure the overall learning output of the program but rather individual courses. As a result, a framework that guarantees the fulfillment of the curriculum's graduate profile, as well as the production of qualified labor for the local, national and international markets is needed. To this end, the Ministry of Education (MoE) devised an exit exam as a framework to achieve the aforementioned and other goals, such as creating a conducive environment for stakeholders’ proper engagement and assessing students’ achievement in their major area.

There are various settings in which an exit exam may be defined. In our case, it is described as a form of assessment that higher education institutions utilize to examine the basic level of competency obtained by its students. It is an assessment that is given to students towards the end of their higher education tenure. Exit exams, according to studies [1], improve student performance, have a positive impact on the job market, and result in faster economic growth. As a result, computer scientists who have completed their higher education can use the exit exam to demonstrate that they have the skills, knowledge, attitudes, and general competencies required by stakeholders worldwide.

First and foremost, this competency and exit exam guideline for the BSc degree in computer science program at higher education institutions in Ethiopia outlines the expected profiles of graduates, such as knowledge, skills, and attitudes. The core competencies are then identified and their course mapping is presented. The courses to be included in the exam are then listed and organized into themes. Finally, concluding remarks are communicated.

# **Expected profiles of graduates**

The three profiles of knowledge, skills, and attitudes are universally acknowledged as being necessary for graduates [2].

* Knowledge ("know-what") is the mastery of fundamental ideas and concepts as well as the application of learning to new situations
* Skills ("know-how") is the ability to complete tasks with predictable outcomes
* Attitudes ("know-why") are intellectual, social, or moral tendencies

# **Competencies and learning outcomes**

## **Core competencies**

The term competency refers to workplace performance, or what a graduate should bring to a job. The concept glues together the above mentioned expected graduate profiles, i.e., Competency=Knowledge + Skills +Attitudes. The core competencies for computer science graduates are listed as follows:

* Design a computer system application, process, or protocol to meet the requirements of users or stakeholders.
* Use a variety of operating systems, programming languages, and software tools effectively.
* Use formal reasoning to justify the correctness of computer science results
* Manage and administer computing systems and resources
* Identify any risks or safety issues that may be involved in the operation of computing equipment in a given context.
* Evaluate systems in terms of general quality attributes and potential tradeoffs presented within the context of the given problem.
* Create a substantial technical document that describes work and plan of a project.

Specifically, in addition to the above mentioned competency areas the expected graduates of computer science graduates need to have the following competencies:

## **Knowledge**

Graduates of computer science are expected to understand both the theoretical and practical aspects of field, as well as the role of computing systems in general. To this end, the ability to apply or justify concepts, methods, and computational proficiency in the field is required. It is, therefore, critical to have comprehensive knowledge and understanding of the following topics:

* The fundamental concepts, principles and theories of computation and the application of computers.
* Software Fundamentals and programming languages
* Systems architecture and infrastructure
* Systems modeling
* Structuring of data and information
* Hardware
* Trends and developments in computer science

## **Skills**

The following skills are also expected from computer science graduates:

* Remembering emerging technologies
* Understanding computer architecture and operating systems
* Applying programming languages and software tools to address issues in the real world
* Analyzing existing computing infrastructures and architectures
* Evaluating systems in terms of general quality attributes and potential tradeoffs
* Creating computer artifacts to solve societal problems by applying system modeling, development, and implementation principles

## **Attitudes**

Graduates of computer science are expected to have a wide range of transferable skills (attitudes), including

* Teamwork: Capable of making a valuable contribution to a development team.
* Communication: Briefly explain technical problems and how to solve them to a range of audiences.
* Handling Ethical Issues in Computer Technology: Recognize and follow the social, professional, and ethical issues that arise from the use of computer technology.

## **Mapping between core Competencies and Selected Courses**

The mapping of core competencies to core courses is shown in Table 3-1. Competency, as previously stated, is expressed in terms of knowledge, skills, and attitudes. The skills are described using Bloom's levels of skill [3], which are composed of six cumulative degrees of skills including remembering, understanding, applying, analyzing, evaluating, and creating.

Table 3‑1 Mapping of core competencies to courses

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Competency Vs Courses | | Computer Programming | Object Oriented Programming | Web Programming | Data Communication and Computer Networking | Wireless Communication and Mobile Computing | Computer Security | Network and System Administration | Fundamentals of Database Systems | Advanced Database Systems | Software Engineering | Introduction to Emerging Technologies | Introduction to Artificial Intelligence | Design and Analysis of Algorithms | Data Structures and Algorithms | Operating System | Computer organization and architecture |
| **Knowledge Element** | **Skills** |
| Programming Languages | Understanding, Applying | X | X | X |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Structuring of data and information | Analyzing |  |  |  |  |  |  |  | X | X |  |  |  |  | X |  |  |
| Systems Modeling | Evaluating, Creating |  |  |  |  |  |  |  |  |  | X |  |  |  |  |  |  |
| Systems architecture & infrastructure | Analyzing, Evaluating |  |  |  | X | X | X | X |  |  |  |  | X |  |  | X |  |
| Software development | Applying, Creating |  |  | X |  |  |  |  | X | X | X |  |  |  |  |  |  |
| Software Fundamentals | Understanding, Applying | X | X | X |  |  |  |  | X | X |  |  |  |  |  | X |  |
| Hardware | Understanding, Remembering |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | X |
| Concepts, principles and theories of computation and the application of computers | Understanding, Remembering | X | X | X | X | X | X | X | X |  | X | X | X | X | X | X | X |
| Trends and developments in computer science |  |  |  |  |  |  |  |  |  |  |  | X | X |  |  |  |  |

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

|  |  |  |  |
| --- | --- | --- | --- |
| No | Curse Code | Course Name | ECTS |
| 1 | EmTe1012 | Introduction to Emerging Technologies | 5 |
| 2 | CoSc1011 | Computer Programming | 5 |
| 3 | CoSc2041 | Fundamentals of Database Systems | 5 |
| 4 | CoSc2041 | Advanced Database Systems | 5 |
| 5 | CoSc2051 | Object Oriented Programming | 5 |
| 6 | CoSc2022 | Computer organization and Architecture | 5 |
| 7 | CoSc2032 | Data Communication and Computer Networking | 5 |
| 8 | CoSc2092 | Data Structures and Algorithms | 5 |
| 9 | CoSc3081 | Web programming | 7 |
| 10 | CoSc3034 | Wireless Communication and Mobile Computing | 5 |
| 11 | CoSc3023 | Operating System | 5 |
| 12 | CoSc3061 | Software Engineering | 5 |
| 13 | CoSc3094 | Design and Analysis of Algorithms | 5 |
| 14 | CoSc3112 | Introduction to Artificial Intelligence | 5 |
| 15 | CoSc4035 | Computer Security | 5 |
| 16 | CoSc4036 | Network and System Administration | 5 |
| **Total** | | | **82** |

A computer science graduate should take 52 courses to graduate, according to the current curriculum. However, including all courses in the competency and exit examination is unrealistic. To that end, the following courses were chosen from among all available options for the competency and exit examination.

Table 4‑1: List of selected Courses

# **Categorizing courses into themes**

Table 5‑1: Courses organized into themes

|  |  |
| --- | --- |
| **Theme** | **Courses** |
| Programming and Web Development | Computer Programming |
| Object Oriented Programming |
| Web Programming |
| Computer Networking and Security | Data Communication and Computer Networking |
| Wireless Communication and Mobile Computing |
| Computer Security |
| Network and System Administration |
| System Development and Database Systems | Fundamentals of Database Systems |
| Advanced Database Systems |
| Software Engineering |
| Emerging Technologies and Intelligent Systems | Introduction to Emerging Technologies |
| Introduction to Artificial Intelligence |
| Algorithms | Design and Analysis of Algorithms |
| Data Structures and Algorithms |
| Computer Architecture and Operating Systems | Operating System |
| Computer organization and architecture |

# **Conclusion**

Core competency and exit examination courses for the computer science BSc degree program were presented in this guideline. Sixteen courses were chosen from a pool of more than 52 courses to assess students' competencies. The courses are further categorized into six themes for comprehension purpose. The courses on the list are fundamental courses that prepare students to compete in the global marketplace.

The exam that is going to be prepared from these courses should focus on concepts that guide for long term knowledge and transfer skills instead of detailed assessment. Furthermore, the courses are subject to change in the event of a curriculum update.

# **References**

1. Woessmann, Ludger. "Central exit exams improve student outcomes." IZA World of Labor (2018).
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3. Anderson, L.W. et al., A taxonomy for learning, teaching, and assessing: A revision of Bloom’s taxonomy of educational objectives, abridged edition, (White Plains, NY Longman, 2001).