Ministry of Education

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

Program: - Civil Engineering in BSc.

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1. Introduction

Civil Engineering undergraduate program is aimed at creating well-qualified Civil Engineers with adequate knowledge in the area of structural, highway, geotechnical and water resources and who can be actively engaged in the planning, development and management of Civil Engineering projects. Currently 33 public higher institutions host Civil Engineering as undergraduate programs and thousands of new graduates join the construction industry every year. It has been reported that most these graduates lack the required competency by the stakeholders who hires them. One of the recommended strategies is the implementation of university exit examination for prospective graduates to tackle this problem. 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. The implementation of exit examination is related to improvement of the quality of higher education. The feedback from the results of exit examination is expected to be contributory for institutional improvement. This draft document is aimed to present the major focus areas which should be included in the preparation of Exit Exam for Civil Engineering graduates.

2. Expected Profiles of Graduates'

A graduate Civil Engineer is expected to have:

- An ability to apply knowledge of mathematics and science in specialized areas related to Civil Engineering.
- An ability to critically analyze and interpret data in major Civil Engineering areas.
- An ability to analysis and design a systems, components, or processes to meet desired needs within realistic constraints such as technical, economic, environmental, social, political, ethical, health and safety, constructability, and sustainability, in major Civil Engineering areas.
- An ability to identify, formulates, and solves Civil Engineering problems in major Civil Engineering areas.
- To conduct experiments, basic and applied research in relation to construction industries to solve various technical, organizational and social problems.
- An ability to use the techniques, skills, modern Engineering tools and software necessary in major Civil Engineering area.

- An understanding of professional practice issues such as project management, contract administration and interactions between the development, design, and construction professions.
- An ability to function in multidisciplinary teams.
- An ability to communicate effectively, orally and in writing.
- An understanding of professional and ethical responsibilities of Civil Engineers.

3. Competencies and Learning Outcomes

3.1 Competency areas in General Science and Engineering

- Apply basic principles of forces and equations of motions under static and dynamic loading conditions.
- Develop appropriate mathematical models that represent physical systems.
- Model and analyze engineering problems by applying concepts of calculus and vector algebra.
- Develop general workshop practical skills.
- Apply appropriate advanced mathematical and numerical method to analyze problems related to Civil Engineering.
- Able to plan analyze and write computer programs for numerical methods and basic Engineering applications.
- Apply concepts of probability and statistics to problem solving in engineering systems.

3.2 Competency areas in Construction Materials

- Get basic knowledge on construction materials for Civil Engineering projects.
- Select suitable construction materials for the perspective Civil Engineering project.
- Develop an engineering solution for problems related to construction materials

3.3 Competency areas in Building Construction

- Identify different elements of building
- Understand different building construction techniques & technologies
- Use different building systems and apply standards, principles in relation to building elements.
- Understand and interpret basic building working drawings

- Apply cost efficient construction principles for building structures and systems to design efficient facilities and optimize their use.

3.4 Competency areas in Construction Management and Contract Administration

- Understand and apply basic construction procurement and contract management processes.
- Understands basic guideline and application of contract formulation and administration; and planning and management techniques/tools of construction projects
- Apply major principles of bidding process, specification writing, quantity surveying, project cost estimation and construction supervision.
- Schedule construction projects with different scheduling techniques and computer applications.
- Perform economic analysis and evaluation of Civil Engineering projects.
- Apply the principles of safety and health in construction project management and take safety and health measures in construction projects.

3.5 Competency areas in Surveying

- Accurately measure distances and angles using high precision and up-to-date surveying equipment.
- Perform quantity of general earth work based on available surveying data.
- Analyze and interpret data independently and come up with maps and digital elevation models for a given plot.

3.6 Competency areas in Competency areas in Structural Analysis and Design

- Get basic knowledge on properties and strength of major construction materials.
- Carry out basic and advance structural frame analysis with various loading conditions using different methods of structural analysis.
- Comprehends structural mechanics of different civil structures and apply the knowledge in the design of the structures
- Analyze and dimension different structural members using Ethiopian and other standards.
- Ability to apply basic design procedures to design different structural members in a manner which ensures the safety and utility of the structure.
- Solve dimensioning and design problems

- Analyze and design of complex structural elements

3.7 Competency areas in Geotechnical Engineering

- Understand the behavior of soil/rock.
- Evaluate engineering properties of soil; determine the bearing capacity, lateral earth pressure and stability of slopes of soil.
- Analyze and design different types of shallow and deep foundations using different technique.
- Understand & interpret the behavior of different types of soils and be able to design foundations for structures which is plan to be constructed on these soils.

3.8 Competency areas in Road and Transport Engineering

- Understand transportation systems and demonstrate ability to plan, analyze, and design the basic elements of an integrated surface transportation system for safe and efficient movement.
- Collect, Analyze and interpret traffic flow data.
- Acquainted with the principles of geometric and pavement analysis and design.
- Acquire basic knowledge and practical prospective of highway materials, construction practice and quality control.
- Evaluate the condition of an existing highway system.
- Identify and solve different geometric and pavement design and material problems.
- Comprehend advanced topics on road construction, maintenance, rehabilitation and pavement management.
- Analysis and design of railway systems.

3.9 Competency areas in Hydraulics, Water Supply & Sanitary Engineering

- Comprehend the basic principles of planning, design and construction of water supply and sewerage systems.
- Comprehends fundamental concepts of fluid mechanics and be able to understand the basic laws of physical science which govern the mechanics of fluid flow.

- Understand the fundamental principles & assumptions involved in pipe flow, flow through turbines and pumps, and dimensional analysis & model studies.
- Analyze hydrologic data, perform the hydrological evaluation of watersheds for design purposes and perform hydrological design for a variety of Civil Engineering projects.
- Understand the basic principle of flow through open-channels and determine water surface profile of open channel.
- Analyze and design hydraulic structures such as dams, spillways, and flood control structures.
- Understand the fundamental techniques used in the analysis and design of hydraulic structures for water resources development projects such as reservoirs, dams & appurtenant structures, diversion weirs, river and watershed management schemes.
- Understand the fundamental theories of river morphology and be able to design and analyze river erosion protection works, flood protection structures, and silt exclusion devises.
- Understand the relationship between soil, water and plant, optimization of water for irrigation and the design criteria for irrigation structures.
- Select appropriate site for hydropower development and design hydropower systems.
- Comprehend the construction, operation and maintenance aspect of hydropower systems and infrastructure.
- Comprehend the water resources system and optimize available water resource.
- Examine the opportunities and challenges associated with the planning, project formulation, sustainability; and environmental impact assessment.

4. Courses to be included in the exam in different thematic areas

4.1 Courses related to Construction Materials, Building Construction and Management

- Construction Materials
- Building Construction

- Specification and Quantity Surveying
- Procurement and Contract Administration
- Engineering Economics
- Construction Equipment
- Construction Management

4.2 Courses related to Structural Engineering

- Theory of Structure (I & II)
- Reinforced Concrete Structures (I & II)
- Steel & Timber Structures
- Fundamental of Bridge Design
- Structural Design

4.3 Courses related to Geotechnical Engineering Courses

- Soil Mechanics (I & II)
- Foundation Engineering (I & II)

4.4 Courses related to Road and Transport Engineering Courses

- Transport Engineering
- Highway Engineering (I & II)
- Railway Engineering

4.5 Courses related to Hydraulic, Water Supply and Sanitary Engineering Courses

- Hydraulic Structures (I & II)
- Irrigation Engineering
- Water Supply and Urban Drainage
- Waste Water and Solid Waste Treatment

5. Conclusion

As a conclusion, these draft documents start with the rationale behind the implementation of Exit Exam which is bringing quality in Ethiopian higher education institutions. The document summarizes the major requirements which are expected from every Civil Engineer up on successful completion of the program. In relation to these requirements major areas of competencies are described and courses which focus on these competency areas are selected which can be taken as the major focus areas in the preparation of exit exam for the students who have finalized their study in the department of Civil Engineering in undergraduate program.

Since Civil Engineering is the broadest of all engineering disciplines and students under this program are required to be equipped with all the fundamental knowledge, skill and attitude related to every sub-discipline in the field, 21 courses in the five thematic areas are selected as a major focus areas for the Exit Exam preparation.