



Ministry of Education

**Test Blueprint for National Exit Examination
2015 E.C**

Band: 1

Program: - Bachelor of Science Degree in Civil Engineering

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Table of Contents

List of tables.....	II
1. Introduction.....	1
1.1. Significance of Test Blueprint Preparation.....	2
2. Expected Profiles of Graduates'	2
3. General objective.....	3
3.1. Specific objectives.....	3
3.1.1. Construction Materials, Building Construction, and Construction Management.....	3
3.1.2. Structural Analysis and Design.....	4
3.1.3. Geotechnical Engineering.....	4
3.1.4. Road and Transport Engineering.....	5
3.1.5. Hydraulic Engineering.....	5
4. Themes and list of courses with total credit hour of the selected courses.....	5
5. Core Competencies.....	6
6. Calculation of share of themes, courses and items from a total of 100 test items for Civil Engineering.....	8
7. Test Blueprint for BSC in Civil Engineering.....	11
8. Conclusion.....	19

List of tables

No table of figures entries found.

1. Introduction

Civil Engineering as defined by the London based Institute of Civil Engineers (ICE) is a great art, on which the wealth and well-being of the whole of society depends. It requires a broad understanding of scientific principles, knowledge of materials and the art of analysis and synthesis. It also requires research, team working, and leadership and business skills. A Civil Engineer is someone who practices all or part of this art.

Civil engineering concerns the study of conceptualization, design, construction and maintenance of large public and private projects. Civil engineers build and maintain bridges, highways, railways, tunnels, airports, dams, water treatment and distribution systems and large buildings, along with many other structures. Environmental considerations, such as water supply, pollution control and preservation of soil quality, are also a part of the course of study. With thorough knowledge of both the principles of construction and the possible environmental consequences of a structure, the civil engineer's expertise is one that is essential to our present civilization and one that will become ever more valuable in the future.

The 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 are host Civil Engineering as undergraduate programs, and thousands of new graduates join the construction industry every year. It has been reported that most of these graduates lack the required competency by the stockholders who hire them. One of the recommended strategies is the implementation of a university exit examination for prospective graduates to tackle this problem. University Exit Exam is a standardized comprehensive curriculum based test that is designed to assess if students have achieved the minimum competence that was stipulated in the graduates' profile. The implementation of exit examinations is related to the improvement of the quality of higher education. The feedback from the results of the exit examination is expected to contribute to institutional improvement. This draft document is aimed to present the major focus areas which should be included in the preparation of the Exit Exam for Civil Engineering graduates.

1.1. Significance of Test Blueprint Preparation

The significance of the test Blueprint Preparation is a guide for designing or pattern that can be followed in making the national exist exam, it captures the skills an organization seeks to own at the end of the program for students. Creating a test blueprint will help plan which questions to include in the national exist exam and ensures that it adequately assesses the learning objectives of the identified core competencies.

Test blueprint preparation is generally opted to assist the preparation of a test that is representative, broadly sampled, and consisting of complete knowledge domain expected of the Ethiopian higher education students on completion of their study program. The specific objectives of test blueprint are to:

- Facilitate the construction of a representative and balanced test items for the selected courses in accordance with the competencies identified.
- Guide test developers or writers to write or set appropriate test items.

2. Expected Profiles of Graduates'

A graduate in Civil Engineer is expected to have:

- An ability to apply knowledge of mathematics and science in a specialized area related to Civil Engineering.
- An ability to critically analyze and interpret data in major Civil Engineering areas.
- An ability to analyze and design 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, and basic and applied research concerning 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 areas.

- 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 the professional and ethical responsibilities of Civil Engineers.

3. General objective

The Civil Engineering department aims to produce professionals equipped with relevant knowledge, skills and attitude that would contribute to the development of the country. Therefore, this is profession by which many Ethiopians would be produced to serve the country. This program is aimed at training manpower required for the realization of the country's untouched Civil Engineering works. 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 will be produced through this program.

- Be knowledgeable of the historical context, the state-of-the-art, and emerging issues in the field of Civil Engineering and its role in contemporary society;
- Demonstrate critical reasoning and requisite quantitative skills to identify, formulate, and resolve Civil Engineering problems, and to create designs that reflect economic, environmental, and social sensitivities;
- Display a systems viewpoint, critical thinking, effective communication and interpersonal skills, a spirit of curiosity, and conduct reflecting a professional and ethical manner;
- Exhibit a commitment to lifelong learning and professional development, involvement in professional activity and public service, and achievement of professional licensure;
- Reflect a broad intellectual training for success in multidisciplinary professional practice, in Civil Engineering or diverse related careers, and toward achieving leadership roles in industry, government, and academia.

3.1. Specific objectives

The program specific learning outcomes (objective) of the BSc degree program in civil engineering can be categorized in to five main thematic areas.

3.1.1. Construction Materials, Building Construction, and Construction Management

- Get basic knowledge of 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
- Identify different elements of a building
- Understand different building construction techniques & technologies
- 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.
- Understand and apply basic construction procurement and contract management processes.
- Understands basic guidelines and application of contract formulation and administration; and planning and management techniques/tools of construction projects
- Apply major principles of the 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.

3.1.2. Structural Analysis and Design

- Get basic knowledge of the properties and strengths of major construction materials.
- Carry out basic and advanced structural frame analysis with various loading conditions using different methods of structural analysis.
- Comprehends structural mechanics of different civil structures and applies 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 that ensures the safety and utility of the structure.
- Solve dimensioning and design problems
- Analyze and design complex structural elements

3.1.3. 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 a different technique.
- Understand & interpret the behavior of different types of soils and be able to design foundations for structures which is the plan to be constructed on these soils.

3.1.4. Road and Transport Engineering

- Understand transportation systems and demonstrate the 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 perspective 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.

3.1.5. Hydraulic Engineering

- Comprehends fundamental concepts of fluid mechanics and can understand the basic laws of physical science which govern the mechanics of fluid flow.
- 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, and river and watershed management schemes.
- Comprehend the construction, operation, and maintenance aspects of hydropower systems and infrastructure.

4. Themes and list of courses with total credit hour of the selected courses

The courses to be included in the exit exam for undergraduate Civil Engineering program can be categorized into five main groups based on their content as shown in Table 2. These categories do not represent modules and courses in the same category may be found in different modules on the curriculum.

Table 1: Selected Core Courses to be included in the exit exam

Thematic area	Courses		CrHrs./ECTS
Construction Materials, Building Construction, and Management	1.	Construction Materials	3/5
	2.	Building Construction	3/5
	3.	Contract, Specification and Quantity Surveying	3/5
	4.	Construction Management	3/5
Structural Engineering	5.	Reinforced Concrete Structures (I & II)	3/5 (each)
	6.	Steel & Timber Structures	3/5
	7.	Fundamentals of Bridge Design	3/5
	8.	Structural Design	3/5
Geotechnical Engineering	9.	Soil Mechanics (I & II)	3/5 (each)
	10.	Foundation Engineering (I & II)	3/5 (each)
Road and Transport Engineering	11.	Transport Engineering	3/5
	12.	Highway Engineering (I & II)	3/5 (each)
Hydraulic Engineering	13.	Hydraulic Structures (I)	3/5
Total Credit Hours			51

5. Core Competencies

The core competencies specific to the civil engineering undergraduate program suggested for the exit exam can be summarized as given in **Table 2**.

Table 2: Core competencies

Learning Domains	Competencies
Knowledge	- Understand properties of construction materials used in Civil Engineering Projects. - Identify Civil Engineering structures and suitable construction techniques. - Understand working drawings. - Understand construction procurement and contract administration process. - Understand structural design philosophies and procedures. - Know the mechanical properties of Civil Engineering materials. - Understand and use relevant design codes and standards. - Understand structural load types and applications. - Understand basic knowledge of soil properties and characterization. - Understand the basics principles of transport planning and modeling. - Comprehend the design and construction aspects of hydraulic structures.
Skill	- Evaluate Engineering properties of construction materials. - Analyze and solve problems related to construction materials. - Prepare material design for Civil Engineering projects. - Apply different construction techniques. - Interpret and use working drawings. - Prepare specification, estimations and contract documents for Civil Engineering projects. - Interpret and use different standards related to Civil Engineering. - Identify and solve problems related to construction management. - Develop and monitor construction project schedules. - Lead and supervise construction projects. - Analyze and design Civil Engineering structural members (sub and super structures).

	- Use Computer-Aided Design (CAD) programs. - Perform and interpret geotechnical investigations. - Plan and design highway and transport systems. - Evaluate and select suitable site for hydraulic structures. - Design and supervise hydraulic structure projects.
Attitude	- Perform works as a team.

6. Calculation of share of themes, courses and items from a total of 100 test items for Civil Engineering

Table 3 : Calculation of share of themes, courses and items from a total of 100 test items for Civil Engineering

Themes	Name of Courses	Credit hours	Weight of course or proportion	Share of the themes in %	Number of test items from each course	Learning outcomes								No. of items
						Cognitive						Affective	Psychomotor	
						Remembering	Understanding	Application	Analysis	Evaluation	Creation/ Synthesis			
Construction Materials, Building Construction, and Construction Management Share = 24 items from the total	1.Construction Materials	3	3/12 = 0.25	$\frac{12}{51} \times 100 = 24$	0.25*24 = 6	1	1	1	1	1		1		
	2 Building Construction and Quantity Surveying	3	3/12 = 0.25		0.25*24 = 6		1	2	1	1		1		
	3. Contract, Specification and quantity surveying	3	3/12 = 0.25		0.25*24 = 6	1	1	1	1	1		1		
	4.Construction Management	3	3/12 = 0.25		0.25*24 = 6		1	2	1	1		1		
	Theme 1 Total Credit	12			24	2	4	6	4	4		4		
Structural Engineering Share = 29 items from the total	1.Reinforced Concrete Structures I	3	3/15 = 0.2	$\frac{15}{51} \times 100 = 29$	0.2*29 = 6	1	1	2	1		1			
	2.Reinforced Concrete Structures II	3	3/15 = 0.2		0.2*29 = 5		1	2		1	1			
	3. Steel & Timber Structures	3	3/15 = 0.2		0.2*29 = 6	1	1	2		1	1			
	4.Fundamentals of Bridge Design	3	3/15 = 0.2		0.2*29 = 6	1	1	2		1	1			
	5. Structural Design	3	3/15 = 0.2		0.2*29 = 6	1	1	2	1		1			

	Theme 2 Total Credit	15			29	4	5	10	2	3	5			
Geotechnical Engineering Share = 23 items from the total	1. Soil Mechanics I	3	$3/12 = 0.25$	$\frac{12}{51} \times 100 = 23$	$0.25 \times 23 = 6$	1	2	1	1	1				
	2. Soil Mechanics II	3	$3/12 = 0.25$		$0.25 \times 23 = 5$	1	1	1	1	1				
	3. Foundation Engineering I	3	$3/12 = 0.25$		$0.25 \times 23 = 6$	1	1	2	1	1				
	4. Foundation Engineering II	3	$3/12 = 0.25$		$0.25 \times 23 = 6$	1	2	2		1				
	Theme 3 Total Credit	12			23		3	6	7	7				
Road and Transport Engineering Share = 18 items from the total	1. Transport Engineering	3	$3/9 = 0.33$	$\frac{9}{51} \times 100 = 18$	$0.33 \times 18 = 6$	1	2	2		1				
	2. Highway Engineering I	3	$3/9 = 0.33$		$0.33 \times 18 = 6$	1	1	2	1	1				
	3. Highway Engineering II	3	$3/9 = 0.33$		$0.33 \times 18 = 6$	1	1	2	1	1				
	Theme 4 Total Credit	9			18		3	5	6	3				
Hydraulic Engineering Share = 6 items from the total	1. Hydraulic Structures (I)	3	$3/3 = 1$	$\frac{3}{51} \times 100 = 6$	$1 \times 6 = 6$	1	1	2	1	1				
	Theme 5 Total Credit	3			6		2	2	2					
		51		100										

7. Test Blueprint for BSC in Civil Engineering (Table 4: Test Blueprint for BSC in Civil Engineering)

Themes	Name of Courses	Credit Hours	General objective	Learning Outcome	Learning outcomes							
					Cognitive						Affective	Psychomotor
					Remembering	Understanding	Application	Analysis	Evaluation	Creation/		
Construction Materials, Building Construction, and Construction Management	1. Construction Materials	3	Introduces the production, nature and characteristics of different construction materials and identify them with respect to their suitability to different Engineering structures. Understand the physical and chemical property of construction materials under different conditions having basic skill how to mix and produce concrete	CLO1 - describe Engineering properties of concrete, steel and other materials related to their use in construction	1							
				CLO2 - assess the significance of environmental factors on the behavior and durability of concrete and steel;					1		1	
				CLO3 - formulate Engineering solutions to problems associated with the use of concrete, steel and other materials;			2					
				CLO4 - Prepare reports on practical exercises relevant to the manufacture and properties of concrete.	1	1						
	2 Building Construction	3	The course introduces students with the different types of buildings, their components and methods of construction. The overall building processes	CLO1 - Discuss about building techniques & structural concepts of masonry construction, Concrete construction, water/damp Proofing & finishing materials.		1						

			beginning from site works will be covered	CLO2 - Discuss about building systems and Identify & apply standards, principles and details of building elements.			1						
				CLO3 - Analyze and develop dry constructions, partition walls, flooring systems, and suspended ceiling systems,				1					
				CLO4 - Interpret advanced construction work of digital building models and drawings.			1		1		1		
				CLO5 - Analyze Cost efficient construction principles for building structures and systems to design energy efficient facilities and their optimized use				1					
	3 Contract Specification and quantity surveying	3	Students will gain knowledge in the legal aspects of contracts and bidding; types of construction documents including bonds; interpretation of technical building specifications and their application to selection and installation of materials, equipment and systems.	CLO1 - Describe the process, applicable laws and regulations of Procurement & Contract Management.	1						1		
				CLO2 - Analyze types of delivery System; clarify their merits & demerits		1							
				CLO3 - Recognize the preparation of tendering process such as Pre-qualification; Opening and Evaluation of bidders; and Post qualification of tender documents				1	1				
				CLO4 - Apply how to manage awarding of contracts; preparation of contract agreements; managing and administration of contract documents including Bonds and Guaranties			1						

	4 Construction Management	3	Time Management, Cost Management, Quality Assurance and Control, Risk Management, Safety and Health in Construction	CLO1 - Explain the nature and functions of construction project management in Ethiopia.		1					1		
				CLO2 - Manage construction project costs and apply earned value management concept.					1				
				CLO3 - Apply the systems, principles and standards of construction quality and assure and control construction quality.			1						
				CLO4 - Plan and analyse risks, apply risk management techniques, and assess and control construction project risks.				1					
				CLO5 - Apply the principles of safety and health in construction project management and take safety and health measures in construction projects.			1						
	Total	12			2	4	6	4	4		4		
Structural Engineering	1.Reinforced Concrete Structures I	3	This course induces the structural analysis and design of reinforced concrete structural members subjected to gravity load.	CLO1 - Understanding Mechanical Properties of concrete and reinforcing steel		1							
				CLO2 - Applying Design Philosophy			1						
				CLO3 - Developing analysis and design of beam for flexure and shear	1				1				
				CLO4 - Developing analysis and design of slabs for flexure and shear				1					
				CLO5 - Apply Ethiopian Building Code Standards for design of RC members.			1						
	2.Reinforced	3	This course induces the	CLO1 - Design of column.		1					1		

	Concrete Structures II		structural analysis and design of reinforced concrete of structural members.	CLO2 - Design the flat slab			1						
				CLO3 - Develop the collapse mechanisms for beam and frame					1				
				CLO4 - Design the slab by yield line method.			1						
	3. Steel & Timber Structures	3	This course induces the structural analysis with design of steel and timber members subjected to gravity and lateral loading along with the connection details.	CLO1 - Students will have the ability to design timber and steel structures, connections, and apply the EBCS for the design purpose.			1						
				CLO2 - Apply Design Philosophy and developing design Formats			1						
				CLO3 - Develop Design for Axially loaded structural members.			1						
				CLO4 - Develop Design for Flexural members	1					1			
				CLO5 -Develop Design for Beam Column joint.									
				CLO6 - Develop Bolted and Welded connections.		1				1			
	4.Fundamentals of Bridge Design	3	To identify the different types of bridges: arch, suspension, truss, beam, cantilever and cable stayed. Learning various loads acting on bridges.	CLO1 - Apply Design Philosophy and specifications for investigating different forms of bridges	1								
				CLO2 - Apply principles for selecting a type of bridge.			1						
				CLO3 - Apply principles of static and dynamic loadings.		1	1						
				CLO4 - Develop Design for Super-structure & Sub-structure components of the bridge.					1				
				CLO5 - Develop Design for bearings of the bridge & culverts						1			

	5. Structural Design	3	This course induces the plastic analysis of frame structures, calculation lateral load on structure and design of detailing and connections.	CLO1 - Develop Plastic Analysis for obtaining the collapse Mechanism of determinate and indeterminate Structures.	1								
				CLO2 - Develop the Strip Method of Analysis for slab.		1		1					
				CLO3 - Develop Earthquake Load Calculation on structure using EBCS-8			1						
				CLO4 - Develop Wind Load Calculation on structure using EBCS-1			1						
				CLO5 - Develop Design of Bolted and Welded connections.						1			
	Total	15			4	5	11	3	2	4	1		
Geotechnical Engineering	1. Soil Mechanics I	3	In this course, students will be introduced to the basic concepts of the physical properties of soils as a civil engineering material and the fundamental principles of soil mechanics.	CLO1 - Understanding and classify soils.		1							
				CLO2 - Evaluate the state of stress in a soil mass.	1			1	1				
				CLO3 - Calculate seepage volume through a soil mass.			1						
				CLO4 - Estimate settlement magnitude of compressible soils and soil stabilization.			1						
	2. Soil Mechanics II	3	To equip students with the basic inputs required for the design and construction of geotechnical structures.	CLO1 - Determine the stress distribution on soil.			1						
				CLO2 - Conduct shear strength tests for soils and interpret their corresponding results.	1								
				CLO3 - Determine bearing capacity of a soil.		1							
				CLO4 - Determine lateral earth pressure.				1					
				CLO5 - Estimate the stability of					1				

			transport planning, and evaluating transport alternatives. Driver, pedestrian, vehicle, and road characteristics. Traffic Engineering studies: spot speed studies, volume studies, travel time and delay studies parking studies and road traffic safety. Fundamental principles of traffic flow: traffic flow elements, and flow-density relationships. Traffic-control devices and systems: traffic signs, pavement markings and islands, and traffic signals. Highway capacity: level of service, capacity of highways, and intersections.	CLO3 - Evaluate the capacity and level of service (LOS) of basic freeway and highway						1			
				CLO4 - Design road furniture and traffic signal timing applying Software's			1						
				CLO6 - Estimate the current and future travel demand				1					
	2.Highway Engineering I	3	Introduction to Highway Engineering, Highway Geometric Design Factors Geometric Design of Highway Alignment, Highway Drainage Design & drainage Structures, Earth work quantity & Mass Haul Diagram, Introduction to Intersection, Road Terminal & Interchanges Introduction to geometric	CLO1 - Explain highway planning process, route selection criteria and engineering survey		1			1				
				CLO2 - Compute and balance earth work in highway design			1						
				CLO3 - Analysis and design of surface and sub-surface side drainages channels				1					
				CLO4 - Distinguish different types of intersection and interchange	1		1						

			design of Airfields											
			Overview of pavement structures & types, Stresses in pavement structures. Traffic volume and loading Sub grade soils, special soil tests for pavement design, soil classification for highway purposes. Unbound pavement materials. Stabilized pavement materials. Bituminous materials: sources and properties of binders; types of asphalt mixtures. Marshall Method of mix design, and surface treatments. Structural design of flexible pavements: AASHTO method of flexible pavement design; Design of flexible pavement structures using ERA and AACRA design procedures, Design of gravel surfaced road using ERA procedures Pavement design for Airfields		1									
							1							
					1		1							
							1							
									1					
	3.Highway Engineering II	3												
	Total	9			3	3	6	3	2	1				
Hydraulic Engineering	1.Hydraulic Structures (I)	3	The course provides students with basic principles of design of dams and its appurtenant		1									
							1							

8. Conclusion

Exit examination can have a vital role in producing knowledgeable, skillful and attitudinally matured graduates. It contributes to prepare competent graduates as it can serve as a quality check for effectiveness. It also helps in improving academic programs quality and effectiveness. Furthermore, it can create the platform for cooperation among academic programs at different universities to work jointly improve the programs quality.

In this view, this document is prepared to assist the setting of the exit examinations for all programs, which is to be delivered by Ministry of Education. To meet the objective of the exit exam, core competency areas and their learning outcomes were already done for 2015 EC graduating students. As a result, preparing test blueprint is necessary to prepare fairly distributing items based on the above criteria and done accordingly.