



Ministry of Education

Test Blueprint Preparation Manual for Exit Examination
Program: - Bachelor of Science Degree in Biosystems
Engineering

Compiled By:

1. Mr. Tarekegn Elias (Hawassa University)
2. Mr. Yosef Mamuye (Hawassa University)

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1. Introduction

The Ministry of Education of Ethiopia has announced the implementation of exit exam for all undergraduate program students (public and private), beginning with the 2022/2023 academic year, in order to improve the quality of graduates produced by higher learning institutions. The exit exam aimed at checking whether students have acquired the required knowledge, skills and attitudes or not. To implement this, it requires determining competency areas for a specific program, which is already completed. Based on the competency areas prepared, it needs to plan the construction of tests.

Planning of a test is a first and vital step in the construction of an achievement test. An achievement test demands very systematic and careful planning, as a fact that good planning is a symbol of success. Tests are the tools that provide scores that measure level of student learning and study program learning outcomes. In order to achieve the valid and reliable measurement of student learning and program learning outcomes, the development of valid and reliable test is the mandatory. Test should be able to measure student performance in all dimensions of knowledge, skill and attitude. The carefully planned test construction contributes to improve the overall quality of the test in terms of test content validity, difficulty level, discrimination power and test reliability. Test preparation is not an easy task; it requires a careful planning and guideline to make the task simple. Test construction needs the preparation of test blue print. Test blueprint is defined as a complete plan

that explains how to develop a test. The term refers to a map or specification of assessment to ensure that all aspects of the curriculum and educational domains are covered by the assessment programs over a specified period of time. It helps curriculum developers/test constructors

to match various competencies with the course content and the appropriate modality of assessment.

Generally, test blueprint will help to ensure tests: 1) Appropriately assess the achievement of instructional objectives of the course; 2) Appropriately reflect key course goals, objectives and the material learned or covered during the instruction period; and 3) Include the appropriate item formats along with the knowledge and skills being assessed.

Keeping this in mind, the team has prepared this test blueprint document in order to help the test developers or content specialists in their process of valid and reliable test construction. The major points considered in the process of preparing this test blue print guideline were the core competencies that have been already identified for the themes of courses, the course contents, course credit hours, and the learning outcomes with their corresponding levels of achievement by learning domains. In line with these, the number of test items that should adequately assess the performance of students in all the content topics will be determined through discussion with the content specialists who construct the blueprint and test for their corresponding study program. Therefore, the main purpose of this manual is to give direction on how to develop blueprint for content specialists so that they can develop a test blueprint for their respective program.

2. Objective of test blueprint

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.

3. Expected Profile of Graduates

This program is aimed at training manpower required for the realization of the use of country's vast Agricultural Engineers professional potential. Well-qualified Agricultural Engineers (Biosystems Engineers) will be produced through this program who can actively be engaged in the planning, design, development and management of Agricultural mechanization projects. Specifically, the trainees will be equipped with the knowledge that enables them to execute the following tasks:

3.1. In terms of Knowledge

- perform tasks as designing, planning, supervising and managing irrigation and drainage schemes,
- perform tasks as planning, supervising and managing flood and water control systems,
- develop ways to conserve and manage soil and water resources with the use of biological and physical interventions,
- apply engineering and technology to agricultural product handling and processing,
- design and manage farm implements and machineries,
- play a decisive role in watershed management
- plan, supervise and manage the building of farmstead structures

- perform tasks as planning, supervising and managing renewable energy resources,
- perform environmental impact assessment
- conduct applied research and interpret results and implement relevant practices based on the felt needs of the society, develop ways to improve the processing of feed and forage

A large percentage of Biosystems Engineering (BEng) graduates work in:

- research institutes, academia or for government agencies such as in Agro-processing industries, the Ministry of Agriculture and Rural Development, Ministry of water Resources Development, Environmental Protection Agency, Regional Irrigation and Drainage Authorities and other Non-Governmental Organizations.
- many are employed by manufacturers of agricultural machinery and equipment; working in production, sales, management, research and development

3.2. In terms of Knowledge

➤ Acquaintance with mathematical techniques and numerical methods
 Knowledge of mechanics and physical sciences, chemistry and biological sciences, basic manufacturing technologies, system analysis in farm implement and machine design, about the mechanics of materials, performance evaluation and testing of farm machineries, farm machinery management, agricultural sciences and application of engineering to agriculture, concepts of entrepreneurship, farm management and economics, farm machinery promotion and sell, renewable energy resources handling and utilization, basic concepts of farm electric installations, electrical machine operation and controls, post-harvest handling and small scale processing of agricultural products, animal feed handling and processing, land surveying and leveling

- Principles and operational knowledge of farm machinery maintenance, basic concepts of CAD (Computer Aided Design), engineering drawing, quantity survey and tender document preparation, fluid flow mechanisms, and heat and mass transfer, concepts of groundwater and surface water hydrology, working know-how of flow measurement in open and closed channels, farmstead structures and greenhouse design and construction.
- Knowledge of integrated watershed management, irrigation scheme design, construction and management, drainage structure design, construction and management, water harvesting structures design, construction and management, project planning and management, soil and water conservation structures design, construction and management, basic concepts of decision support system management.
- Knowledge to conduct applied research
- Design and manage
 - farmstead structures
 - agricultural tools & implements
 - small scale farm electrical installation plan
 - household level food processing devices
 - small scale feed processing devices
 - biomass related energy processing plants
 - farm machineries
 - sales, marketing and promotion of agricultural machineries
 - maintenance of agricultural machineries
 - evaluation and testing of farm machineries
 - conducting environmental impact assessment
 - developing technologies that optimize livestock production
 - post-harvest handling of agricultural products
 - supervision of food, feed, and fiber processing or manufacturing operation

- conducting research
- consulting activities related with Biosystems Engineering discipline

The graduates will have the capacity to innovate, transfer technology & entrepreneurship. He/she can understand the way of creating new business idea, competitiveness contributes to new business products, and also the entrepreneurship traits and skills needed in entrepreneurship. Furthermore, the B.Sc. degree in Biosystems/Agricultural Engineering as the first academic degree may also be the starting point for further academic qualification as for example in the framework of post-graduate studies in various related fields such as:

- Agricultural Mechanization Engineering
- Soil and Water Conservation Engineering
- Renewable /sustainable Energy Resource
- Irrigation and Drainage Engineering
- Agricultural product Process Engineering
- Postharvest Technology
- Geo informatics and Geodesy Engineering
- Water Supply and Environmental Engineering
- Integrated River Basin Management
- Soil and Water Conservation Engineering

3.3. In terms of Attitude

Attitude about entrepreneurship on the program and create a job

Increase in labor productivity, land productivity and decrease cost of production. An Attitude of Perception availability and utilization of modern agricultural technology. An Attitude of Perception on water availability and utilization of these resources for sustainable development

Attitude of making citizen of Ethiopia to be food self-sufficient by applying modern agricultural farming techniques to increase productivity

4. General objective of the Program

The general objectives of the Program are

- i. Provide excellent undergraduate Agricultural Engineering education that is relevant, academically sound and characterized by an appropriate balance of theory and application at par with the professional standard.

5. Specific objectives

The Specific objectives of the Program are

- Conduct research to develop technologies, processes, products, and strategies to support efficiency and sustainability in agricultural, food, biological, and natural resource systems synergistic with the training program.
- Provide technical assistance and educational programs to farmers and small producers, agricultural businesses and industry, in order to improve production efficiency and profitability and to assist decision makers in agricultural production, value-added processing, and natural resources management
- Contribute towards enhancement of the agricultural production and fostering conservation and management of natural resources through teaching, research, and outreach to increase the profitability and sustainability of agriculture, and protect the environment for improved quality of life; Extend the program to reach out to urban and rural beneficiaries provide continuing education and life-long learning opportunities for the community

6. Themes and list of courses

This is basically focused on the courses that will be categorized based on the Biosystems Engineering curriculum as of the following table.

Table2. Categorizing Courses in to Themes

Themes and list of courses			
Themes	Course Name	Course ECTS	Themes ECTS
Processing Engineering Module	Processing Engineering I	4	8
	Processing Engineering II	4	
Energy Module	Alternative Energy Resources	5	5
Mechanization Module Team	Farm implements & Machinery	4	29
	Selection and Management of Farm Machinery	5	
	Maintenance of Agricultural Machinery	5	
	Performance Evaluation & testing of Farm machineries	4	
	Farm Power Units	5	
	Hydraulics and Pneumatics Power Control	4	
	Tractor Operation I	2	
Soil and Water Engineering & Watershed Management Module Team	Soil and Water Conservation Engineering I	4	21
	Soil and Water Conservation Engineering II	4	
	Land Evaluation and Watershed Management	4	
	Soil Physics and Mechanics	4	
	Irrigation Engineering	5	

7. List of courses and Total ECTS

Table1. Selected Courses for the Exit Exam

No.	Selected Courses for the Exit Exam	Course ECTS	Themes ECTS
1	Processing Engineering I	4	8
2	Processing Engineering II	4	
3	Alternative Energy Resources	5	5
4	Farm implements & Machinery	4	29
5	Selection and Management of Farm Machinery	5	
6	Maintenance of Agricultural Machinery	5	
7	Performance Evaluation & testing of	4	

	Farm machineries		
8	Farm Power Units	5	
9	Hydraulics and Pneumatics Power Control	4	
10	Tractor Operation I	2	
11	Soil and Water Conservation Engineering I	4	21
12	Soil and Water Conservation Engineering II	4	
13	Land Evaluation and Watershed Management	4	
14	Soil Physics and Mechanics	4	
15	Irrigation Engineering	5	
Total ECTS/ Course or Themes		63	63

8. Share of the Themes/Courses/Items in Percentage

Ministry of Education (Table 1)
Higher Education Sub-sector
Test Blueprint (Table Specification) for BSC/BA/BED in __1__

Themes and Share of the themes in %	Name and Share of the Courses in %	Cr . ho ur	General objective/Compete ncy	Specific objectives /learning outcomes	Learning outcomes								No. of items
					Cognitive						Affective	Psychomotor	
					Remembering	Understandin	Application	Analysis	Evaluation	Creation/			
Processing Engineerin g 12.69 %	Processing Engineering I 50%	4	Apply engineering and technology to agricultural product handling and processing	Identify the scope of agricultural	2								9
				processing and diversity of food materials stored in plants and animals,		3							
				Understand and describe the principles and technologies employed in food processing,				1					
				Understand and describe mechanical unit operations, harvesting, cleaning, grading, filtration, centrifugation, size reduction,					2				
	Processing Engineering II 50%	4	identify & categorize various products based on their post-harvest behaviors;	To design construction and manage packinghouse and storage structures; handling system and environmental control of store structures.	1					1			10
			evaluate post-harvest losses with their causes & recommend appropriate measures to maintain their quality;	To illustrate post-harvest systems		2		2					
				To design machines for post-harvest processing using computer aided design; To design				2		2			

	Control 14%		agricultural machinery, aspects of control engineering and control instrumentation in hydraulic and pneumatic devices and modeling and simulation.	theory, classification and performance of hydraulic systems (: pumps, hydraulic cylinders, Hydraulic motors, etc.), as well as identify their components		2	2		1	1	-	-	10
	Tractor Operation I 7%	2	knowledge about the safety precaution, handle the tractor in a proper way, drive the tractor with and without a trailer, forward and backward and hitch an implement to the three-point linkage of the tractor	Know the safety rules associated with driving the tractor	1								2
				To understand the principles behind driving the tractor with low and high gear forward and backward, driving the tractor with trailer, coupling an implement to the three-point linkage of the tractor		1							
	Soil and Water Conservation Engineering I 19%	4	This course is intended, to introduce students with natural resources and their rate of depletion	Conceptualize natural resources and the need for their conservation,									9
			to equip students with the tools required for soil loss assessment and estimation	Identify types of erosion, types of water erosion and hydrologic cycle, Conceptualize process and mechanics of soil erosion by Water,	2								
			to introduce students with the basic concepts of soil erosion mechanisms, and factors	Identify factors affecting wind erosion, Model wind erosion, model soil erosion (Prediction Models for Soil Loss), estimate soil loss, Identify the purpose and		3		-	2	-	-	-	

				Conceptualize gully erosion and its control, gully formation/initiation and development, gully classifications, erosion process in gullies, gull erosion damages,									
Land Evaluation and Watershed Management 19%	4	The course will enable students to understand and describe physical, technical and socio-economic considerations and effects of land and watershed management interventions in a watershed, at different levels	enhance appropriate use of the land resources in the watershed and thus developing forest and fodder resources	Identify the need for land evaluation, Evaluate land capability and suitability,	2								
				Identify the approaches to land evaluation for rain fed and irrigation purposes,									
				Understand Concepts and assumptions in land capability classification and Evaluate land characteristics and land qualities that affect agricultural production,		3	-	-		-	-	-	7
				understand the relations between soil, water, land use and land management with in their agro-ecological, socio-economic and political environment					3				

			and have the knowledge and skills to apply inventerization techniques and the design and implementation of land evaluation measures	suitability Classifications. Describe the need for a water shed management; the role of such approach for sustainable land use, and the relevant issues to consider before implementation		3							
			The course gives students the required knowledge and skill in fundamentals of soil physics and Mechanics,	The students will be able to Identify and define soil physical properties and constituents	2	-	2	-	-	-	-	-	7
			in plant-water-soil interactions, in the kinematics of soils	Describe the basic concepts and identify the parameters behind the principles water retention in soil: Conceptualize, describe and quantify water flow in soils using mathematical theories, describe and calculate solute transport in soil									
Soil and Water Engineering & Watershed Management 33.33%	Irrigation Engineering 24%	5	The course gives students the required knowledge and skill in basics of surface irrigation methods	The students will be able to, Define of irrigation and identify the benefits and Ill effects of irrigation the source of irrigation water		3	1		1	-	-	-	8
			on pressurized irrigation methods	describe the Quality of Irrigation Water and classify irrigation water, Describe soil-water	2								

[illegible]

9. 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 to improve the programs quality.

In view of this, this document is produced to assist the setting of the exit examinations for all programs, which is being delivered by Ministry of Education. To meet the graduation profile, competency and learning outcome, exit exam competency selection and identifying core course was done for 2015 EC graduating students. As a result, preparing test blueprint is necessary to prepare fairly distributed items based on the above criteria.

Appendix

Table 2: Example for the calculation of share of themes, courses and items from a course from a total of 120 test items for one program

Themes	Course Name	Learning outcomes	Credit hour	Weight of course or proportion	Number of test items from each course	Cognitive						Affective	Psychomotor	Total
						Remember	Understand	Apply	Analyze	Evaluate	Create			
Processing Engineering Share = 19 items from the total	Processing Engineering I		4	$4/8 = 0.5$	$0.5 \times 19 = 10$	2	3	1	1	2	-	-	-	9
	Processing Engineering II		4	$4/8 = 0.5$	$0.5 \times 19 =$	1	2	2	2	2	1	-	-	10
	Theme one total credit		8											19
Energy Share = 9 items from the total	Alternative Energy Resources		5	$5/5 = 1$	$1 \times 9 = 9$	2	2	2	1	-	2	-	-	9

	Theme two total credit		5											9
Mechanization Share = 52 items from the total	Farm implements & Machinery		4	$4/29 = 0.14$	$0.14 * 52 = 7$	3	2	2	-	2	-	-	-	9
	Selection and Manageme nt of Farm Machinery		5	$5/29 = 0.17$	$0.17 * 52 = 9$	1	2	-	3	2	-	-	-	8
	Maintenan ce of Agricultur al Machinery		5	$5/29 = 0.17$	$0.17 * 52 = 9$	2	1	2	-	-	-	-	-	5
	Performan ce Evaluation & testing of Farm machineri es		4	$4/29 = 0.14$	$0.14 * 52 = 7$	1	2	1	1	3	-	-	-	8
	Farm Power Units		5	$5/29 = 0.17$	$0.17 * 52 = 9$	3	3	2	1	1	-	-	-	10

	Hydraulics and Pneumatic s Power Control		4	$4/29 = 0.14$	$0.14*52 = 7$	2	2	2	2	1	1	-	-	10
	Tractor Operation I		2	$2/29 = 0.07$	$0.07*52 = 3$	1	1	-	-	-	-	-	-	2
	Theme three total credit		29											52
Soil and Water Engineering & Watershed Management	Soil and Water Conservati on Engineerin g I		4	$4/21 = 0.19$	$0.19*38 = 7$	2	3	2	-	2	-	-	-	9
Share = 40 items from the total	Soil and Water Conservati on Engineerin g II		4	$4/21 = 0.19$	$0.19*38 = 7$	1	2	2	2	-	1	-	-	8
	Land Evaluation and Watershed Manageme nt		4	$4/21 = 0.19$	$0.19*38 = 7$	2	3	-	1	3	-	-	-	8

	Soil Physics and Mechanics		4	$4/21 = 0.19$	$0.19 \times 38 = 7$	2	3	-	2	-	-	-	-	7
	Irrigation Engineering		5	$5/21 = 0.24$	$0.24 \times 38 = 9$	2	3	1	1	1	-	-	-	8
	Theme three total credit		21											40
Total for the program			63			27	34	19	17	19	6	-	-	120

Table 4: Linking the Curriculum to Course/program Learning Outcomes

	Course	Level of Emphasis					
		1 = Some Emphas is	Modera te Emphas is	Substant ial Emphasi s			
Processing Engineering	Processing Engineering I	Identify the scope of agricultural processing and diversity of food materials stored in plants and animals,			X		
		Understand and describe the principles and technologies employed in food processing,					X
		Understand and describe mechanical unit operations, harvesting, cleaning, grading, filtration, centrifugation, size reduction,				X	
	Processing Engineering II	To design construction and manage packinghouse and storage structures; handling system and environmental control of store structures.					X

		To illustrate post-harvest systems		X	
		To design machines for post-harvest processing using computer aided design;	X		
Energy	Alternative Energy Resources	To categorize energy resources and identify forms of energy sources		X	
		To design solar energy appliances: solar water pump, water heater, etc.		X	
		To understand the basic design and principle of operation of the devices/machines for the conversion of energy from Wind, Water power: wave, tidal, hydro and Geothermal.			X
Mechanization	Farm implements & Machinery	describe the Farm mechanization and its scope; machinery for primary and secondary tillage and their objectives; classification and calibration of planting machines, force analysis			X
		Design principles of tillage implements; fertilizer and manure application machinery; different types of sprayers and dusters; harvesting equipment: threshers, combines, and forage harvesters, mowers and balers.		X	
	Selection and Management of Farm Machinery	Identify mechanization options	X		
		Analysis and Pass decisions concerning the use, replacement and choice among mechanization inputs.			X
		Calculate farm machinery and equipment costs (: fixed and variable costs), calculate Timeliness and Field efficiency; and to calculate equitable custom rates.		X	
	Maintenance of Agricultural Machinery	identify common damages in agricultural machinery (: wear, corrosion, fatigue, ageing); permissible limits of damages	X		
		Understand engine trouble shooting and practice on inspection and adjustment some engine parts: valves, injection nozzle		X	
		To carryout servicing of engine components, fuel system, cooling system, lubrication system and electric system;		X	
	Performance Evaluation & testing of Farm	identify testing standards in Ethiopia and elsewhere;			
		Understand and describe the methods/techniques and equipment used for the measurement of tractor PTO, Draw-bar and Hydraulic performances.			X

	machineries	Calculate tractor performance: engine power, PTO Power, drawbar power, wheel slip, fuel consumption, etc.		X	
	Farm Power Units	Identify and describe exhaust systems, lubrication system, fuel system, cooling system and electrical system of tractors; as well as power trains; PTOs; hydraulic system of tractors; steering systems; and brakes system			X
		An understanding of the principle of operation and every component of both spark ignition and compression ignition engines, as are those operating on four-stroke and sufficient knowledge on the different system of a tractor		X	
	Hydraulics and Pneumatics Power Control	define, formulate and relate the physical properties of hydraulic fluids	X		
		Understand and describe the theory, classification and performance of hydraulic systems (: pumps, hydraulic cylinders, Hydraulic motors, etc.), as well as identify their components		X	
	Tractor Operation I	Know the safety rules associated with driving the tractor	X		
		To understand the principles behind driving the tractor with low and high gear forward and backward, driving the tractor with trailer, coupling an implement to the three-point linkage of the tractor	X		
Soil and Water Engineering & Watershed Management	Soil and Water Conservation Engineering I	Conceptualize natural resources and the need for their conservation,	X		
		Identify types of erosion, types of water erosion and hydrologic cycle, Conceptualize process and mechanics of soil erosion by Water,			X
		Identify factors affecting wind erosion, Model wind erosion, model soil erosion (Prediction Models for Soil Loss), estimate soil loss, Identify the purpose and type of models, estimation of runoff.		X	
		Analysis of the physics of rainfall, rainfall erosivity, erodibility of soil, sediment propulsion and sediment transport, formulate the erosion and sediment yield factors affecting water erosion, erosion damages by		X	

		water,			
	Soil and Water Conservation Engineering II	Understand damages of wind erosion and methods to control it	X		
		Conceptualize water erosion control measures and conceptualize and device agronomic and biological practices in soil conservation;		X	
		Design erosion control structures on agricultural lands (: bunding, terracing, diversion drains, cut off drains, land leveling and grading, waterways);			X
		Device measures for reclamation of degraded land, Control of stream bank erosion	X		
		Design hydraulic structures for soil and water conservation; Conceptualize gully erosion and its control, gully formation/initiation and development, gully classifications, erosion process in gullies, gull erosion damages,		X	
	Land Evaluation and Watershed Management	Identify the need for land evaluation, Evaluate land capability and suitability,	X		
		Identify the approaches to land evaluation for rain fed and irrigation purposes,	X		
		Understand Concepts and assumptions in land capability classification and Evaluate land characteristics and land qualities that affect agricultural production	X		
		Identify major kinds of land use and land utilization types, Land use requirements, relation between land characteristics and land qualities, different evaluation methods and suitability Classifications.			X
		Describe the need for a water shed management; the role of such approach for sustainable land use, and the relevant issues to consider before implementation		X	
	Soil Physics and Mechanics	The students will be able to Identify and define soil physical properties and constituents	X		
		Conceptualize, describe and quantify water flow in soils using mathematical theories, describe and calculate solute transport in soil			X
	Irrigation	The students will be able to define irrigation and	X		

	Engineering	identify the benefits and Ill effects of irrigation the source of irrigation water			
		describe the Quality of Irrigation Water and classify irrigation water, Describe soil-water relationship and water movement in soil, as well as		X	
		Describe the methods employed in the measurements of irrigation water, classify and design water application methods		X	

