Ministry of Education

Test Blueprint Preparation Manual for Exit Examination

Program: Bachelor of Science Degree in Petroleum engineering

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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 the Graduate

Graduating petroleum engineering students should be able to accomplish the following tasks with about 6 months of on-the-job training;

- Adequate skills including understanding of scientific and engineering

concepts, effective oral and written communication, ability to participate in life-long learning, diverse and global professional careers, project management and decision making.

- Strong foundation in engineering principles and practices, based on the learning of fundamentals of engineering, ability to use advanced techniques, and participation in relevant engineering interactions.
- Enhanced problem-solving skills that involve designing and conducting experiments, analyzing and interpreting laboratory as well as field data, innovation and conceptual thinking, and applying engineering through research and/or industrially oriented projects.
- Ability to understand important issues, such as knowledge and appreciation of the codes of ethics, awareness and appreciation for health, safety and environmental issues, integrating ethical, social, health, safety, and environmental issues into practical projects, economic evaluation and risk assessment, awareness of international standards and specifications.

Working skills in multi-disciplinary teams; functioning with peers from other disciplines, integrating information and data from multiple sources, participating in technical seminars and industrial/professional functions and events, and adaptability to different working environments

4 Objectives (General and specific)

The objective of the exit exam is to gauge the level of students' understanding of what they were supposed to have learned in the field of study and to measure actual academic capabilities of graduating students. In this context, the objective of the exit exam is to assess whether students have attained the learning outcome of the petroleum engineering program, which they have attended. The following are key of objectives of the exit exam;

- To encourage students to put more effort into their studies, and to develop good habits of continuous learning and self-improvements
- To meet the educational, research and service needs of the country by producing high quality graduates

- To produce skilled and competent manpower for national and international market
- Assessing students’ educational achievement in major areas of Petroleum Engineering
- To assess whether the graduation profile of the Petroleum Engineering curriculum has achieved at least common standards of knowledge and practical skills

- To improve stakeholders' trust and confidence in the Petroleum Engineering activities from professional point of view
- To solicit the students input in order to revise the core learning outcomes of the courses covered by the exit examination
- To ensure all graduating students from HEIs(Higher Education Institutions) satisfy the needs of the labor market and enhance employability by implementing nation-wide competency-based exit exam
- To create competitive spirit among Petroleum Engineering departments in different universities within the country and to encourage adaptation of national standards

1. Themes list of courses and allocated Credit hour

The society of petroleum engineers (SPE) has significantly updated its core competency matrices for the petroleum engineering program in September 2021, and new graduating students are expected to have critical set of skills. SPE's Engineering Professionalism Committee has developed competency areas/categories, which in this case was condensed into five categories.

Courses required in each category are;

Category 1: HSE, Sustainability and General Petroleum Engineering

- Petroleum HSE (Health, Safety and Environment)
- Mechanics of Materials- (Statics & Dynamics)
- Fluid Mechanics

Category 2: Drilling and Completions Engineering

- Drilling Engineering
- Introductory Applied Structural Geology
- Well Completion and Design

Category 3: Reservoir Engineering

- Reservoir Engineering
- Petroleum Economics and Asset Evaluation
- Enhanced Oil Recovery (EOR)

Category 4: Production Engineering, Facilities Design and Projects

- Production Engineering

- Fundamentals of Liquefied Natural Gas (LNG)
- Project Management in The Oil and Gas Industry
- Petroleum Surface Facilities Design and Operations

Category 5: Data Science and Engineering Analytics

- Data Science in Petroleum Using Python
- Numerical Methods for Engineers

Table 1: List of Petroleum Engineering courses for the Exit Exam

S No	**Course name**	**Credit hours**	**ECTS**
1	Petroleum HSE (Health, Safety and Environment)	3	5
2	Mechanics of Materials- (Statics & Dynamics)	3	5
3	Fluid Mechanics	3	5
4	Drilling Engineering	3	5
5	Introductory Applied Structural Geology	3	5
6	Well Completion and Design	3	5
7	Reservoir Engineering	3	5

8	Petroleum Economics and Asset Evaluation	3	5
9	Enhanced Oil Recovery (EOR)	3	5
10	Production Engineering	3	5
11	Fundamentals of Liquefied Natural Gas (LNG)	3	5
12	Project Management in The Oil and Gas Industry	3	5
13	Petroleum Surface Facilities Design and Operations	3	5
14	Data Science in Petroleum Using Python	3	5
15	Numerical Modelling for Engineers	3	5

6. Share of the themes/courses and KSAs in percentage

Using the bellow formulas

Percent share for Theme i = $\frac{Total\,Credit\,hour\,of\,the\,Theme\,i}{Total\,Credit\,hour\,of\,the\,Program\,i}$x100

Percent share for Course i = $\frac{Credit\,hour\,for\,Course\,i}{Total\,Credit\,hour\,of\,the\,Theme\,i}$x Percent share for Theme i

Total test items for Theme i = $\frac{Total\,Credit\,hour\,for\,Theme\,i}{Total\,Credit\,hour\,for\,Program\,i}\,X\,Total\,of\,items$ for the program

Total of items for course = $\frac{Credit\,hour\,for\,Course\,i}{Total\,Credit\,hour\,for\,Theme\,i}\,X\,Total\,number\,of\,items\,for\,Theme\,i$

Themes and Share of the themes in %	Name and Share of the Courses in %	Credit hour	General objective/Competency	Specific objectives /learning outcomes	Learning outcomes								
					Cognitive						Affective	Psychomotor	No. of items
					Remembering	Understandin	Application	Analysis	Evaluation	Creation/			
HSE, Sustainability and General Petroleum Engineering (share for the theme 25%)	Petroleum HSE (Health, Safety and Environment) (8%)	3	This course covers one of the most important aspects of the petroleum industry; namely HSE (health, safety and environment) stewardship in all phase petroleum resources exploitations.	Understand the technical guidelines of HSE to each operation		2							
				Learn HSE risk management and key performance metrics to track				2					
				Understand HSE complexities in upstream industry, and how to manage it		1							
				know how carry out root-cause analysis in a HSE accident					1				
				Understand the financial cost of mismanaging HSE in petroleum operations		1							
				Understand corporate responsibility to HSE (health, safety and environment), and why investors are demanding it		1							
				Learn major industry case-studies in HSE in the petroleum industry			2						
	Mechanics of materials (Dynamics and statics) (8)	3	This course outlines the principles of mechanics applied to different materials and to develop solving skills through the applications of this principles to basics engineering problems	Student will be able to solve a variety of engineering problems		3							
				Behavior of axially load numbers		1	2						
				Torsion of circular shafts		1	2						
				stress and reflections					1				
	Fluid Mechanics (8)	3	This course outlines reservoir management two phase flow in pipes occurs and also covers pressure	student will learn characteristics and properties of fluid	2	2				1			
				Flow properties of fluids Balance equation	1		2			1			

Note other tables are in the appendix

7. Learning outcomes in terms of three domains (cognitive, affective, psychomotor)

After completing their BSc training those courses presented on the mentioned themes, graduating students will be able to:

- Demonstrate knowledge in using common petroleum engineering terminology, Understand general terminology common to all sub- disciplines.
- Identify and use relevant industry and company design standards, Identify API, ISO & Corporate. Standards & RPs exist in all sub-disciplines.
- Maintain regulatory compliance, identify what regulatory bodies have jurisdiction and where to find documentation of the applicable regulations. Describe the essential rules and approval process relevant to the work project.
- Identify and use technical software and informational databases, Identify technical software and informational databases that exist for all sub-disciplines. Outline utility verification, limitation definition and cost benefit analysis processes.
- Use project management skills, Differentiate the elements (costing, scheduling, contracting, logistics, etc.) and phases (initiation, planning, execution, closure) of project management.
- Understand and apply Geo science and Geo-mechanical principles, Discuss Geo science and Geo-mechanical principles (e.g., fracture gradients, well bore stability, pore pressure prediction, gross and net pay, porosity, dip, seal to the existing terms).
- Promote engineering professionalism, Maintain membership in technical and professional societies and pursue professional license and/or certification.
- Problem solving, Solve problems by analyzing situations and apply critical thinking.
- Ability to apply scientific and technical expertise, Demonstrate a basic understanding of all job

knowledge skills, procedures and processes; know resources to seek guidance for clarification as needed.

- Stakeholder Engagement and Social Performance, Understand the key benefits and costs that upstream oil & gas development brings to local, regional and global communities.

2. **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.

Exit exam of graduating students that measure learning outcomes, graduate profiles and whether university program meets the quality standards of the profession. The petroleum engineering exit exam will contain fifteen courses in five areas of specialization.

Appendix

Table 2: Example for the calculation of share of themes, courses and items from a course from a total of 150 test items for one program

Themes	Course Name	Learning outcomes	Cr. Hrs.	Weight for the course	Number of Test Items for each	Cognitive Domain								
						Remember	Understand	Apply	Analyze	Evaluate	Create	Affective	Psychomotor	Total
HSE, Sustainability and General Petroleum Engineering (30)	Petroleum HSE (Health, Safety and Environment)		3	3/9= 0.33	0.33*30= 10	-	2	2	1	2	1	1	1	10
	Mechanics of Materials-		3	3/9= 0.33	0.33*30= 10	1	2	2	1	2	1	1	-	10

	(Statics & Dynamics)													
	Fluid Mechanics		3	3/9= 0.33	0.33*30= 10	-	1	-	2	2	1	2	2	10
						1	1	1	2	1	2	1	1	10
Sub-total			9			2	6	5	6	7	5	5	4	
Drilling and Completions Engineering (30)	Drilling Engineering		3	3/9= 0.33	0.33*30= 10	-	2	2	2	2	1	1	1	10
	Introductory Applied Structural Geology		3	3/9= 0.33	0.33*30= 10	1	1	2	1	2	1	1	2	10
	Well Completion and Design		3	3/9= 0.33	0.33*30= 10	-	2	2	2	2	1	-	1	10
						1	2	1	2	1	2	1	-	10
						1	2	2	1	2	1	-	1	10
Sub-total			9			3	9	8	8	9	6	3	6	
Reservoir Engineering (30)	Reservoir Engineering		3	3/9=0.33	0.33*30= 10	1	1	2	1	2	1	-	2	10
	Petroleum Economics and Asset Evaluation		3	3/9=0.33	0.33*30= 10	-	1	2	2	2	1	1	1	10
	Enhanced Oil		3	3/9=0.33	0.33*30= 10	1	2	1	2	1	2	1	-	10

	Recovery (EOR)													
						2	4	5	6	5	4	2	3	
Sub-total			9			3	19	21	21	24	16	4	12	
Production Engineering, Facilities Design and Projects (40)	Production Engineering		3	3/12=0.25	0.25*40=10	2	1	2	-	2	1	2	2	10
	Fundamentals of Liquefied Natural Gas (LNG)		3	3/12=0.25	0.25*40=10	1	2	1	2	1	2	-	1	10
	Project Management in The Oil and Gas Industry		3	3/12=0.25	0.25*40=10	2	1	-	2	2	1	-	2	10
	Petroleum Surface Facilities Design and Operations		3	3/12=0.25	0.25*40=10	1	2	1	2	1	2	-	1	10
Sub-total			12			6	6	4	6	6	6	2	6	
Data Science and Engineering Analytics (20)	Data Science in Petroleum Using Python		3	3/6=0.5	0.5*20=10	2	1	1	2	1	2	-	1	10

	Numerical Methods for Engineers		3	3/6=0.5	0.5*20=10	-	1	1	2	1	2	2	1	10
subtotal			6			2	2	2	4	2	4	2	2	
Total for the program			45											150

Note: The number of items assigned in the levels of domains is based on the nature of learning outcomes/objectives.