Ministry of Education

Test Blueprint for National Exit Examination to be held in 2015 E.C

Band: ___2____

Program: - Bachelor of Science Degree in Chemistry

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Addis Ababa

Ethiopia

Test Blueprint Template Contents

Contents Page

1. **Introduction** 3
2. **Objective of test blueprint** 4
3. **Expected Profile of the Graduates** 4
4. **General Objectives** 6
5. Specific objectives 7
6. **Themes and list of courses** 7
7. **Total credit hour of the selected courses** 7
8. **Share of the Themes/Courses/Items in Percentage (%)** 8
9. **Conclusion** 14

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 are determined through discussion with the content specialists who construct the blueprint for their corresponding study 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 Graduates

- To provide students with abroad and balanced foundation of chemical knowledge and practical skills.
- To develop the ability to apply chemical knowledge and skills to the solution of theoretical r and practical problems in chemistry.
- To instilling students an appreciation of the importance of chemistry in an industrial, environmental and social context

Cognitive

- Master the fundamentals of chemistry including an understanding of broad conceptual and theoretical elements

- Possess an understanding and appreciation of the theoretical bases, methodologies and characteristics of learning of chemistry, research and creative work in chemistry
- An understanding and appreciation of current issues and debates in chemistry
- Continue further specialized educations
- Work as an industrial chemist in chemical processing industries
- Serve as a research/graduate assistant in research / higher education institutions
- Create job opportunities by the acquired chemical knowledge
- Contribute to the development of chemical industries with other professionals
- Enthusiastic about scientific ideas, discovery and learning
- Analyze and solve complex problems on chemistry issues
- Synthesize, characterize and study chemical compounds
- Have critical understanding of technical and scientific tools
- Manage and perform projects activities

Skill

- Possess critical, conceptual and reflective thinking, intellectual openness and curiosity, creativity and originality
- Recognize when information is needed and locate, evaluate and use this information effectively
- An ability to access, identify, organize and communicate chemical knowledge effectively
- An ability to work independently as well as part of a team or group
- An ability to lead in the community, professional associations etc.
- An ability to undertake numerical calculations and understand quantitative information
- Perform qualitative and quantitative chemical analysis in chemical laboratories
- Work as quality controllers in industries
- Knowledgeable in IT and data processing skills in relation to chemical information
- Knowledge about the history, cultural and societal geo-economic integration of the people of Ethiopia

Attitude

- Value intellectual integrity, respect for truth and for the ethics of research and scholarly activity
- Demonstrate environmentally conscious attitude
- Conduct assigned and professional activities with integrity and professional ethics
- Contribute to the development of chemical industries with other professionals
- Disseminate chemical knowledge
- Enthusiastic about scientific ideas, discovery and learning
- Self-discipline and an ability to plan and achieve personal and professional goals
- Willingness to engage in constructive public discourse and to accept social and civic responsibilities
- Respect for the values of other individuals and groups, and an appreciation of human and
  cultural diversity
- An awareness of international and global dimensions of intellectual, political and economic activities, and behaving as a responsible citizen

4. General Objectives

The objectives of undergraduate program in chemistry are:

- Produce well trained and skilled chemists capable of taking up positions in the growing demand of the various sectors of the economy such as various industries, learning institutions, research institutions, as well as various environmental conservation endeavors of the country;
- Disseminate knowledge in chemistry and related areas through active participation in related professional activities, such as Chemical Society of Ethiopia, Regional Networking, Workshops, Symposia and Publications
- Develop capabilities for the provision of consultancy and technical services as well as short term specialized training to both public and private sectors
- To produce chemists who create job opportunities by applying the acquired knowledge and skills.

5. Specific objectives

- An ability to identify, formulate, and solve broadly defined technical and scientific problems by applying knowledge of mathematics and science and/or technical topics to Industrial Chemistry.
- Ability to formulate or design a system, process, procedure or program in chemical industries to meet desired needs.
- Synthesize, characterize and study chemical compounds
- An ability to develop and conduct experiments analyze and interpret data and use scientific judgment to draw conclusions.
- An ability to understand ethical and professional responsibilities and the impacts of technical and scientific solutions in global, economic, environmental, and societal contexts.
- Ability to demonstrate an understanding of major concepts in all five major disciplines of chemistry: analytical, Applied, inorganic, organic and physical.

6. Themes and list of courses

- The Applied Chemistry courses are categorized into five thematic areas. They are:
  1. Analytical Chemistry
  2. Inorganic Chemistry
  3. Organic Chemistry
  4. Physical Chemistry
  5. Applied Chemistry

7. Total credit hour of the selected courses

Total credit hour of the selected courses are 47 **Credit hours**.

Courses to be included in the Exit Exam

	Themes	**Courses**	**Cr hr**
1	Analytical Chemistry	Analytical Chemistry	3
		Instrumental Analysis I	3
		Instrumental Analysis II	3
		Practical Instrumental Analysis I	1
		Practical Instrumental Analysis II	1
		Real Sample Analysis	2
2	Inorganic Chemistry	Inorganic Chemistry I	3
		Inorganic Chemistry II	3
		Practical Inorganic Chemistry I	1
		Practical Inorganic Chemistry II	2
3	Organic Chemistry	Organic Chemistry I	3
		Organic Chemistry II	3
		Practical Organic Chemistry I	1
		Practical Organic Chemistry II	1
4	Physical Chemistry	Chemical Thermodynamics	3
		Kinetic and Electrochemistry	3
		Practical Physical Chemistry I	1
		Practical Physical Chemistry II	1
5	Applied Chemistry	Industrial Chemistry I	3
		Industrial Chemistry II	3
		Environmental Chemistry and Toxicology/Environmental Chemistry(ASTU)	3
	Total		**47**

8. Share of the Themes/Courses/Items in Percentage (%)

- Share of themes (T) = $\frac{a}{b}\ x100$, Where "a" is the credit hour of a theme and "b" is the total credit hour of the program. Credit hour of a theme is the sum of credit hours of courses in the theme.
- Share of courses per theme (C) = $\frac{Credit\ hour\ of\ the\ course}{Credit\ hour\ of\ the\ theme}\ x100$
- Share of items per course = $Share\ of\ the\ course\ X\ Total\ number\ of\ items$

Ministry of Education (Table 1)

Higher Education Sub-sector

Test Blue Print Table Specification for BSc in Chemistry

S.N.	Themes	Shares of the themes	Names of the Course	Cr. Hours	Shares of course	General Objectives	Specific Objectives	Shares of the Competencies		
								Cognitive	Affective	Psychomotor
1.	Analytical Chemistry	28%	Analytical Chemistry	3	23%	Understand chemical analysis (qualitative and quantitative) capacity by using various chemical analysis techniques	Mention the different methods of chemical analyses;	100%		
							Describe the properties of solutions and chemical equilibria			
							Discuss the application of solubility product principle and complex ion formation reactions in chemical analyses;			
							Apply different statistical tests to analytical data and indicate the reliability of experimental results;			
			Instrumental Analysis I	3	23%	Know the operational principles of Scientific Instruments	Compare and contrast classical and instrumental methods with respect to speed, sensitivity, precision, ease of automation, etc;	100%		
							Describe underlying principle governing the chromatographic techniques;			
							Distinguish the various chromatographic methods and their applications;			
							Define electrophoresis and describe its application in chemical analysis			
			Instrumental Analysis II	3	23%	Understand different spectroscopic techniques for structural elucidation of Compounds	Use the basic information emanating from the spectra of different spectroscopic methods;	100%		
							Discuss the qualitative and quantitative applications of different spectral analysis;			
							Distinguish the similarities and differences between MS and other spectroscopic techniques (AAS, UV-Vis, IR and NMR);			

							Elucidate the structure of compounds using the spectral data (UV-Vis, IR, NMR and MS)			
			Practical Instrumental Analysis I	1	8%	Acquires practical skills in carrying out chemical analysis using chromatographic and electroanalytical techniques	Apply the different qualitative and quantitative techniques in their future career	75%		25%
							Identify different parts of selected instruments and describe their respective functions.			
							Describe the similarities and differences that exist among various electroanalytical methods.			
							Perform different experiments using electroanalytical techniques for the quantitative determination of components in a given sample			
			Practical Instrumental Analysis II	1	8%	Develop the practical skills in carrying out chemical analysis by using spectroscopic techniques	Operate and run different spectroscopic instruments and generate spectrum of a given substance;	50%		50%
							Elucidate structure of a compound using joint spectroscopic techniques.			
							Interpret quantitative analytical results from spectroscopic spectra			
							Utilize UV-Vis spectroscopic methods for quantitative determinations a given species from biological samples			
			Real Sample Analysis	2	15%	Perform systematic analysis of real samples	Identify preparation methods for analysis of metals by different methods;	75%		25%
							Perform experiments on food, water, and soil;			
							Familiarize the students with the techniques of sampling, storage, and analysis of real			
2.	Inorganic Chemistry	19%	Inorganic Chemistry I	3	33%	Understand the chemistry of main group elements	Write & explain the electronic configurations of representative elements	100%		
							Explain the basic concepts of chemical bonding and structure			
							Describe various acid-base theories			
							Explain the descriptive chemistry of representative elements			
			Inorganic	3	33%	Understand the chemistry of	Describe group properties of the	100%		

			Chemistry II			d-block and f-block elements	transition elements; Explain coordination compounds with respect to their formation, nomenclature, geometry, isomerism and bonding theories (VBT, CFT and MOT) Describe metallurgical process in transition elements Summarize the descriptive chemistry of transition elements			
			Practical Inorganic Chemistry I	1	11%	Conduct experiments on selected transition elements	Explain the group properties of the selected transition elements Prepare and identify properties of compounds of selected transition elements.	50%		50%
			Practical Inorganic Chemistry II	2	23%	Synthesis and characterization of some inorganic metal complexes	Design and prepare inorganic metal complexes Characterize inorganic metal complexes through physicochemical and spectrometric techniques Identify inorganic metal complexes using their characteristic spectral and physical properties	33%		67%
3	Organic Chemistry	17%	Organic Chemistry I	3	38%	understand the structures, reactivities, synthesis of simple organic compounds and the relationships between structure and properties	Name common organic compounds Identify various functional groups in organic molecules Devise the preparation and reactions of common organic functional groups, Explain importance of stereochemistry and identify different types of isomers in organic molecules Describe mechanisms of addition, substitution, elimination and rearrangement reactions.	100%		
			Organic Chemistry II	3	38%	Know the chemistry of aromatic compounds, amine, and carbonyl compounds	Elaborate the concept of the aromaticity Describe the mechanism of electrophilic and nucleophilic aromatic substitution reactions Describe the various chemical properties and reactions of carbonyl compounds and amines Explain various preparative methods of	100%		

							biological molecule			
			Practical Organic Chemistry I	1	12%	Develop basic laboratory skills in organic chemistry such as survey of some functional groups	Discuss the techniques used to purify contaminated organic compounds Carry out survey of organic functional groups in laboratories Synthesize soap and aspirin Use various techniques to separate organic. compounds from a mixture			100%
			Practical Organic Chemistry II	1	12%	Synthesis different organic molecules involving basic chemical reactions	Carry out small-scale laboratory synthesis involving esterification, dehydrations, acetylation, etc Synthesize various dyes Interconvert one class of organic compounds to others			100%
4	Physical Chemistry	17%	Chemical Thermodynamics	3	38%	enable students to describe chemical and physical changes mathematically by computing the change in properties of the system	Describe the properties of gases Explain the laws of thermodynamics Apply the laws of thermodynamics	100%		
			Kinetic and Electrochemistry	3	38%	understand gaseous properties, rate of chemical reactions and electrochemistry,	Explain electrochemistry Apply the concept of conductance for analysis Indicate the principle of electrolytic conduction Apply the concept of chemical kinetics to predict mechanism of reaction	100%		
			Practical Physical Chemistry I	1	12%	Enable students develop skill of analysis and do independent work through prediction of various physical properties of substances.	Develop some techniques of determination of physical properties matter Work with different instruments of analysis.	50%		50%
			Practical Physical Chemistry II	1	12%	Enable students develop skill of analysis of compounds based on the electrochemical and optical characteristics of substances	Measure conductance of electrolyte in solution Analyze sample with different electrochemical methods			100%
5	Applied Chemistry	19%	Industrial Chemistry I	3	33%	Understand industrial process, unit operations, and production of some important	Describe the basic industrial activities Discuss the physic-chemical properties of water and different types of wastewater	100%		

						chemicals	treatment processes			
							Discuss about the types of fertilizer and manufacturing methods			
			Industrial Chemistry II	3	33%	Know basic organic industrial processes such as coal, main petrochemicals, plastics, rubber agrochemicals, etc	Appreciate processes of coal and petroleum into value added products.	80%	20%	
							Explain industrial organic synthesis			
							Discuss the properties of plastics, rubber, fibers			
							Explain the chemistry of Oils, fats, Soaps, detergents, Pharmaceuticals, Dyestuffs and Insecticides			
							Describe Sucrose, Paper, Leather and Food processing			
			Environmental Chemistry and Toxicology/ Environmental Chemistry(ASTU)	3	34%	Understand the concept Environmental chemistry, common causes of environmental pollution and pollution mitigation methods.	Identify the common causes of environmental pollution;	80%	20%	
							Describe about Aquatic Chemistry and water pollution;			
							Explain about Atmospheric Chemistry and Air pollution;			
							Appreciate and familiarize with the concept of Green Chemistry			
							distinguish some toxic organic chemicals and their effects			

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.