Ministry of Education

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

Program: - Software Engineering in BSc.

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1 Introduction

With the ever-changing demand of the software engineering professionals in various local and international industries, it has become to produce graduates equipped with the required knowledge, skill and attitude needed by the industries. This has necessitated the need to evaluate the knowledge, attitude and skill set of the software engineering graduates using the identified competencies and focus areas of the software engineering curriculum and against the ever-increasing industry demands of this program.

Software engineering program, being one of the ever evolving and demanded program in this era, should strive to align itself to this objective. The stakeholders who are taking part in this program should mandate themselves in working towards ensuring the knowledge, attitude and skill set of its graduates against these core competencies and quality objectives.

The benefit of evaluating and certifying the software engineering graduates against the identified competencies and focus areas are manyfold. It helps to certify the graduates based on the competency requirements of the software engineering, to win the trust of the industries to consume and employee the graduates and to introduce a sense of hard work in the mindset of the graduates early in their academic years thereby enabling them to explore and dig further for the relevant skill sets of software engineering program that is needed by the market.

The intent of this draft document for software engineering is to provide a framework within which to conceptualize the competency areas that should be covered and addressed by the exit exam to be prepared in the future. This document comprises of list of core courses that are expected to measure the student's competency in the software engineering program. For simplicity and better management of the competency areas, the courses have been clustered into themes. Overall, the software engineering exit exam for Ethiopian higher institutions have been prepared ultimately aiming to, maintain the program and graduates quality through evaluating graduates against the curriculum objectives so as to increase local and international industries trust on our graduates.

Overall, the software engineering exit exam for Ethiopian higher institutions have been prepared with the following objectives in mind

2 Objectives of the Exit Examination

The national public administration exit exam shall have the following objectives

- To produce skilled and competent manpower to national and international market
- Assessing students' educational achievement in major areas of public administration and development management (PADM)
- Ensuring whether the graduation profile of PADM curriculum have achieved at least common standards of knowledge and practical skills
- Improving public trust and confidence in public administration activities of professionals
- Facilitating the efforts of students to revise the core learning outcomes of the courses covered by the exit examination
- Ensuring all graduates from HEIs satisfy the requirements of the labor market and employability through the national wide implementation of competency-based exit exam
- Creating competitive sprit among PADM departments in Ethiopia with the vies to encouraging them to give due attention to the national standards

3 Significance of the Document

It is important to set competency areas of the subject matter (program) in order to measure the how much graduates are acquired with skills, knowledge and attitudes. The following shows us the significance or setting competencies and identifying core courses of the program;

- To set competencies that helps to assess the basic skills, knowledge and attitude of graduating students;
- To systematically identify the core courses which will be included the exit exam;

4 Expected Profile of the Graduate

This exit exam is expected to measure the software engineering graduates knowledge, skill and attitude so that they:

- Use current techniques, skills, and tools necessary for software development, testing, and maintenance.
- Have the knowledge and innovative skills to plan, set up and run software related businesses.
- Understand best practices and standards of software engineering program and their application.
- Have the required software project management skill that enable them to manage complex software projects
- Understand professional, ethical, legal, security and social issues and responsibilities.
- Have ability to apply knowledge of computing and mathematics to resolve on-hand and upcoming problems.
- Have recognition of the need for, and an ability to engage in, continuing professional development and the knowledge and skills to act as research assistants or lecturers in higher education institutions

5 Competency and Learning Outcome

Software engineering graduates are expected to demonstrate the following knowledge, skill and attitudes:

Knowledge

- Conduct investigation of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions
- Adopt, innovate, select, and apply appropriate state of the art software design and development tools, methodologies, resources, and emerging technologies including simulation, prediction and modeling for complex business process with understanding of their potential capabilities, limitations and associated risks.
- Apply logical reasoning and informed decision to assess societal, health, safety, privacy, security, legal and cultural issues, and the consequent responsibilities relevant to software engineering application
- Understand the impact of software applications in societal and environmental contexts and apply the principle of green computing for sustainable development.

- Identify, formulate, research literature, and analyze complex problems, reaching substantiated (justifiable, validated) conclusions using software development principles, methodologies, and tools.

Skill

- Design integrated and efficient software solutions, component, or processes to address complex problems and implement them to meet the specified needs with appropriate consideration for public health and safety, cultural, societal (local and international) and environmental considerations.
- Communicate effectively on complex business and system activities with the software engineering community and with a society at large; such as being able to comprehend and write effective reports, articles and design documentations using various tools, make effective presentations and give and receive clear instructions.
- Demonstrate knowledge and skill on software project management principles and apply these to manage software development processes and its resource requirements, costs in multidisciplinary projects
- Apply knowledge of mathematics, and software engineering specialization to address complex and large-scale problems.

Attitude

- Apply ethical principles and commit to professional ethics and responsibilities and norms of software engineering practice.
- Function effectively as an independent software engineer, as a member or as a leader in a diverse team and multidisciplinary settings.
- Recognize the need for and have the preparation as well as ability to engage in an independent and lifelong learning in the information and knowledge economy.

6 Categorizing and selected courses into themes

To help demarcate the focus areas and competency boundaries that are covered by the identified courses, the courses have been categorized under six themes. Accordingly, Table 1 maps courses to the respective themes identified.

Table 1: Courses categorization based on themes

S/N	Themes		Courses to be included in the Exit Exam	ECTS
1	Problem analysis and programming	1	Computer Programming	7
		2	Fundamental of Data structure and analysis	7
		3	Object Oriented Programming	5
		4	Web Design and Programming	7
		5	Mobile Application Development	5
		6	Fundamentals of Database	5
2	Networking and Software Security	7	Fundamentals of Networking	5
		8	Software and information security	5
3	Software requirement, Design, and construction	9	Fundamentals of Software Engineering	7
		10	Requirement Engineering, Architecture and Design	7
4	Software project management and quality assurance	11	Software Project Management	5
		12	Software Testing, Verification and Quality Assurance	7
5	Operating system and computer organization	13	Operating System and System Programming	5
6	Miscellaneous	14	Artificial Intelligence	5
		15	Big data Modeling	5

7 Conclusion

It is crystal clear that evaluating the graduates against the core competencies set out by the curriculum and in line with the industry needs would be important to boost the trust of the employers on the graduate's skill. To realize this, it has become relevant to have a guideline that could be used as reference to prepare a comprehensive exit exam that could address the relevant focus areas of the software engineering program.

To this end, this document was prepared with the intent to highlight the core competency areas of software engineering curriculum, taking in to account and anticipating the market demand of the software engineering professionals sought by the local and international industries and to assess the graduate's knowledge, skill and attitudes towards that end.

Finally, it is assumed that the outcome from the software engineering exit exam could be used as a feedback loop for policy makers. It is believed that the outcome from the exit exam would be significant and be used as input for policy makers who are engaged in curriculum development based on the exit exam outcomes of the graduates by modifying or incorporating new competencies into the curricula and taking other remedial actions that might improve the software engineering graduates skill set.

As a recommendation, we suggested that it is good practice to communicate the exam content areas and scopes for each course to the students a head of the exit exam. This would guide students where they need to focus much time for some courses with extended and vast contents.

Also, as exceptional recommendation, we suggest the relevant body to entertain some universities for exceptional causes. For instances, Wollo university 2015 batch graduates would not take Artificial intelligence and Big data modeling courses. Therefore, there should a mechanism by which 2015 batch students from this university could be excepted form these two courses during the exit exam.

Appendix I. List of courses in Software Engineering program

Table 2: List of courses in Software Engineering program

S/N	Themes		Courses to be included in the Exit Exam	ECTS
1	Problem analysis and programming	1.	Computer Programming I	7
		2.	Fundamental of Data structure and analysis	7
		3.	Object Oriented Programming	5
		4.	Web Design and Programming	7
		5.	Mobile Application Development	5
		6.	Fundamentals of Database	5
		7.	Advanced programming	5
		8.	Design and analysis of algorithm	5
		9.	Advanced database	5
		10.	Computer Programming I	5
2	Networking and Software Security	11.	Fundamentals of Networking	5
		12.	Software and information security	5
		13.	Distributed system	5
		14.	Fundamentals of Cloud Computing	5
3	Software requirement, Design, and construction	15.	Fundamentals of Software Engineering	7
		16.	Requirement Engineering,	7
		17.	Software Architecture and Design	5
		18.	Human Computer Interaction	5
		19.	Component based Software Architecture	5
4	Software project management and quality assurance	20.	Software Project Management	5
		21.	Software Testing, Verification and Quality Assurance	7

		22.	Software Metrics	5
		23.	Software Engineering Tools and Practices	5
		24.	Software Evolution and Maintenance	5
5	Operating system and computer organization	25.	Operating System and System Programming	5
		26.	Computer Organization and Architecture	5
		27.	Real Time and Embedded System	5
		28.	Microprocessor and Assembly Language	5
		29.	Principle of Compiler Design	5
6	Miscellaneous	30.	Artificial Intelligence	5
		31.	Big data Modeling	5
		32.	Fundamentals of Machine Learning	5
		33.	Computer Graphics and Multimedia	5