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

Program: - Automotive Engineering in BSc.

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1. Introduction

Automotive Engineering is a profession that deals with the design, selection, assembly, commissioning, operation, and maintenance of automotive machineries, equipment, and industrial systems.

Professional Automotive Engineers could have the following involvement:

On ground, sea moving and air born machineries, objects and systems such as; passenger cars, trucks, motorcycles, vehicle, and, construction and agricultural equipment 's, ensuring any parts can be sourced when large-scale vehicle assembly commences, developing new test procedures, using both conventional and innovative methods, re-engineering and adapt (modify systems and components) of car technologies, design parts and systems of cars to meet desired needs, engage in research works in alternative sources of energy for cars, Organize, manage, supervise, and check quality of technical and personal activities (reception, maintenance, repair, assembly, purchasing, sales or delivery of spare parts and cars) in Automotive sector, devising and organizing tests, which will answer questions from clients, consumers and other engineers involved in vehicle development, update knowledge and adapt to the ever-changing technology in automotive engineering, managing all details of projects, including projected costs, apply scientific methods to investigate and solve design failures or unexpected maintenance problems in cars, academic, research and development institutions.

Implementing of exit exam for automotive engineering program to graduate, will have effective implementation in empowering well skilled, trained and competent citizens in attitude, skill and knowledge. Beside it is important that to evaluate whether graduate have attained the required competencies with desired skill, knowledge and attitude during the study of the program. Implementing an exit exam as an intervention strategy is one of the best ways to check whether students achieved the desired level of competency and learning outcome with relevant skill, knowledge and attitude.

In this regard, the Ministry of Education (hereafter MOE) has been working on a strategy to implement exit exams for undergraduate programs beginning from the 2015 E.C (2022/23 G.C).

1.1 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 Automotive Engineering
- Ensuring whether the graduation profile of the Automotive Engineering curriculum has achieved at least common standards of knowledge and practical skills
- Improving stakeholders' trust and confidence in Automotive Engineering 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 spirit among Automotive Engineering departments in Ethiopia with the vies to encouraging them to give due attention to the national standards

1.2 Significance of the Document

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

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

2. Expected Graduates Profiles

Graduate profiles are statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that the students acquire in their matriculation through the program.

The profile of B.Sc. Graduates of Automotive engineering can be summarized in the following Competences:

- ✓ Be able to install and maintain automotive systems.
- ✓ Be able to use measuring instruments and utilize laboratory equipment's.
- ✓ Able to maintain machine, workshop and safety equipment's
- ✓ Undertaking Preventive and Corrective Maintenance
- ✓ Involve in research and development activities.
- ✓ Able to innovate and transfer technology.
- ✓ Be able to connect and operate automotive systems and to be able to carry out fault Diagnosis/maintenance of simple circuits and systems
- ✓ Able to design and develop products /components and or systems
- ✓ Be able to apply Reverse Engineering.
- ✓ Involve in the preparation of technical specifications, procurement and sales of machineries/equipment.
- ✓ Be able to demonstrate computational skills and software (CAD) applications.
- ✓ Design IC Engines and or reciprocating machines
- ✓ Be able to work in collaboration with mechanical,electrical, electronics and Computer engineers in design and operation of equipment, with attendant development of a habit of concurrent engineering
- ✓ Manage transport sectors
- ✓ Practice Motor vehicle engineering as a service profession that must be practiced with integrity, honesty, and objectivity.
- ✓ Use the knowledge acquired with discretion and become responsible to the automotive Engineering profession and to our modern global society.

To assure those professionals, an exit exam may help a university make pertinent decisions to improve the quality of institution-wide education and, in some cases, can help assess the standard of education in specific courses. Exit exams are also regarded as helpful in instituting

a system of accountability and transparency through which students, instructors, higher education institutions, and academic leaders can be measured for their success or failure, based on student outcomes.

Based on the graduation profile, competency, and learning outcomes, some courses are considered to be included in the exit exam.

3. Competencies and Learning Outcomes

The Automotive Engineering profession can be acquired and mastered by graduates who are well educated to enter into and dedicate to continue growing in the profession.

3.1 Core Competencies

The core competency of Automotive engineering related to skills, attitude and knowledge in an undergraduate degree program acquires many requirements. An undergraduate Automotive Engineering program meant to produce such graduates must be designed to provide the students with a sufficiently broad and deep base of the following requirements:

3.1.1 Knowledge Requirement:

- Advanced mathematical techniques of calculus, differential equations and numerical methods
- Fundamentals of Engineering Sciences, phenomena, and relationships of solid mechanics and thermo-fluids, including their limitations.
- Knowledge of Engineering Graphics and CAD.
- Knowledge of fundamentals of automotive engineering, IC engine and vehicle systems
- Knowledge of designing products, maintenance, and repairing of vehicle systems and components.
- Exposure to electrical and electronic circuits and machines.
- Knowledge of vehicle management
- Principles and practices of personnel management and supervision.
- Basic concepts of technical management and accounting, including project management and evaluation, material management and the like.
- Knowledge of appropriate technologies

3.1.2 Technical Abilities and Skills

All graduate automotive Engineers are required

- to analyze needs and requirements when designing vehicle
- to design a system, component, or process to meet user needs
- to operate relevant computer software for design/analysis/optimization
- to inspect faults and failures of automotive systems and components
- to interpret written directions, specifications, plans, and drawings
- to test and inspect vehicle performance.
- to determine compliance of products with specifications
- to identify, formulate, and solve engineering problems
- to design and conduct experiments, as well as to analyze and interpret data
- to manage the fleet and transport

3.1.3 Analytical/Computational skills

- to apply mathematical analysis and computational methods for solving engineering problems
- to apply modeling, simulation, and visualization techniques to mimic the system behavior for predictive control and to test different solutions

3.1.4 Attitudes

- Problem Identification through root-cause analysis
- Problem-solving using cause-effect relationships, logical thinking, and an open mind (overcoming mental blocks).
- to comprehend the scheme of things when configured/reconfigured assembled/disassembled by visualization.
- to group together things or actions in a specific order/pattern using a specific rule/set of rules.
- Understanding the implications of new information for both current and future problem-solving and decision-making.
- The ability to apply general rules to specific problems to produce a reasonable solution.
- The ability to combine pieces of information to form general rules or conclusions.
- Considering the relative costs and benefits of potential actions to choose the most appropriate one.
- Motivating, developing, and directing people as they work, identifying the best.

3.2 Major Learning Outcomes

The main program outcomes of this B.Sc. degree in Automotive engineering are the following:

- Complete working knowledge of the fundamental principles that support Automotive Engineering.
- Design and conduct experiments, as well as analyze and interpret data.
- Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- Ability to function in a multidisciplinary team.
- Ability to identify, formulate and solve engineering problems.
- Ability to communicate effectively.
- The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
- Engage in life-long learning and knowledge of contemporary issues.
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

4. Categorizing Courses into Themes

Following the identification of the core competency areas on the harmonized curriculum, courses are categorized under thematic competence areas. Accordingly, the following courses have been identified to be included in the exit exam.

Category 1: Automotive Engines

- IC Engine and Reciprocating Machines
- Diesel and Gasoline Engine Overhauling
- Diesel Mechanics
- Vehicle Performance Evaluation and Testing
- Engine Design

Category 2: Modern Automotive

- Automotive Electrical and Electronics System I
- Automotive Electrical and Electronics System II
- Modern Automotive System Technology
- Automotive air conditioning system

Category 3: Basic Automotive

- Suspension and Ride Control
- Automotive Power Train

Category 4: Machinery and Equipment Technology

- Construction Machinery and Heavy Equipment Technology

Category 5: Automotive Mechanics and Body Engineering

- Vehicle Dynamics
- Vehicle Body Engineering and Aerodynamics

Category 6: Automotive Management

- Fleet Management (Logistics) and Vehicle driving

S. No	Themes	Course Names	ECTS	Main Learning outcomes		
				Knowledge	Skill	Attitude
1	Automotive Engines	IC Engine and Reciprocating Machines	5	✓	✓	
		Diesel and Gasoline Engine Overhauling	5	✓	✓	
		Diesel Mechanics	5	✓	✓	
		Vehicle Performance Evaluation and Testing	5	✓	✓	
		Engine Design	5	✓	✓	✓
2	Modern Automotive	Automotive Electrical and Electronics System I	5	✓	✓	✓
		Automotive Electrical and Electronics System II	5	✓	✓	✓
		Modern Automotive System Technology	5	✓	✓	✓
		Automotive air conditioning system	3	✓	✓	✓
3	Basic Automotive	Suspension and Ride Control	5	✓	✓	
		Automotive Power Train	5	✓	✓	
4	Machinery and Equipment Technology	Construction Machinery and Heavy Equipment Technology	5	✓	✓	✓
5	Automotive Mechanics and Body Engineering	Vehicle Dynamics	5	✓	✓	
		Vehicle Body Engineering and Aerodynamics	5	✓	✓	
6	Automotive Management	Fleet Management (Logistics) and Vehicle driving	5	✓	✓	

NB. The category might not indicate as the courses are in the same module.

5. Conclusion

If implemented effectively, exit examinations can have a vital role 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 program quality.

In view of this, this document is produced to assist the setting of the exit examinations for Automotive Engineering program, which is being delivered by four government universities. To meet the graduation profile, competency and learning outcome in the profession of automotive engineering, exit exam competency selection and identifying core course for undergraduate automotive engineering is drafted to 2015 EC graduates

The exam will contain fifteen courses in six themes. The exam will be given to five higher education institutes. The selected courses shall be crosschecked with all those institutes' curriculum before finalized the documents.