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Ministry of Education

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

Program: - Mechanical Engineering in BSc.

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1. Introduction

Mechanical Engineering is a profession that deals with the design, manufacturing, selection, installation, commissioning, operation, and maintenance of all forms of machinery, equipment, and industrial systems. The profession plays a vital role in the establishment and sustainable operation of a nation's manufacturing industries, transport systems, power generation, construction, and mining industries.

Professional mechanical engineers could have the following involvement:

- ✓ Product design, development, and manufacturing;
- ✓ Industrial plant design, equipment selection, plant erection, commissioning, operation, and maintenance;
- ✓ Industrial gas- and water-supply system/component design;
- ✓ Automotive and construction equipment design and maintenance;
- ✓ Energy conversion system/component design, installation, commissioning, operation, and maintenance;
- ✓ Heating, refrigeration, air-conditioning system/components design, installation, commissioning, operation, and maintenance;
- ✓ Industrial project design and evaluation;
- ✓ Project management;
- ✓ Factory and technical service management in the capacity of general manager, technical manager, operation manager, maintenance manager, and sales manager.

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.

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2. Expected Profiles of Graduates'

Due to his/her strong background, a B.Sc. mechanical engineering graduate can accomplish the following tasks after a brief period of on-job training:

- Represent machine and parts drawing manually and/or with CAD software.
- Understand operating principles of machinery and systems and prepare the specification.
- Design small machinery, piping, and other systems
- Conduct strength analysis of machine components
- Plan production process and assembly of parts
- Determine and optimize production costs
- Determine the layout of machinery and supervise machinery installation.
- Manage the maintenance of equipment
- Control the quality of products.
- Optimize energy utilization in plants.
- Manage the operation of thermal power plants, renewable energy conversion systems, and HVAC systems.
- Design, develop, operate, and maintain rolling stocks.

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3. Competencies and Learning Outcomes

The Mechanical 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 mechanical engineering related to skills, attitude and knowledge in undergraduate degree program acquires many requirements. An undergraduate Mechanical 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:

1. Engineering Knowledge
2. Problem Analysis
3. Design/Development of Solutions
4. Investigation
5. Modern Tool Usage
6. The Engineer and Society
7. Environment and Sustainability
8. Ethics
9. Communication
10. Individual and Team Work
11. Life-long Learning, In short, the program should give due emphasis to the integration of knowledge and skill to enable its graduates to enter the profession.

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3.2. Major Learning Outcomes

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

- Complete working knowledge of the fundamental principles that support Mechanical 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.

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4. Selected course for Exit Exam of Mechanical Engineering

Based on the graduation profile, competency, and skills, fifteen courses are selected. The exam will focus on the main key of the courses.

Courses

1. Engineering Materials (I & II)
2. Strength of Materials (I & II)
3. Manufacturing Engineering (I & II)
4. Engineering Mechanics II- Dynamics
5. Maintenance of Machinery
6. Fluid Mechanics
7. Pneumatics and Hydraulics
8. Heat Transfer
9. Engineering Thermodynamics (I & II)
10. Quality Management
11. Instrumentation and Measurement
12. Introduction to Mechatronics
13. IC Engine and Reciprocating Machines
14. Machine Elements (I & II)
15. Turbo machinery

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5. Category of Courses into Themes

The courses are categorized into four main themes. Those are based on the area of course contents as well as their engineering fields.

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

Category 1: Mechanics, Materials, and Manufacturing

- Engineering Materials (I & II)
- Strength of Materials (I & II)
- Manufacturing Engineering (I & II)
- Engineering Mechanics II- Dynamics

Category 2: Engineering Thermo-Fluid and Fluid Power System

- Fluid Mechanics
- Pneumatics and Hydraulics
- Heat Transfer
- Engineering Thermodynamics (I & II)

Category 3: Control Engineering and Quality Management

- Instrumentation and Measurement
- Introduction to Mechatronics
- Quality Management

Category 4: Machinery Design and Maintenance Related

- IC Engine and Reciprocating Machines
- Machine Elements (I & II)
- Turbomachinery
- Maintenance of Machinery

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Conclusion

To meet the graduation profile, competency and learning outcome in the profession of mechanical engineering, exit exam competency selection and identifying core course for undergraduate mechanical engineering is drafted to 2015 EC graduates. The exam will contains fifteen courses in four themes. The exam will be given to thirty six higher education institutes. The elective courses in the stream under mechanical school are **excluded** and major courses only are considered. The selected courses shall crosschecked with all those institutes' curriculum before finalized the documents.