



Identified Competency Focus Areas and Core Courses for National University Exit Examination

Program:-

- ✓ Bachelor of Science Degree in Electrical and Computer Engineering
- ✓ Bachelor of Science Degree in Electrical Engineering
- ✓ Bachelor of Science Degree in Electrical Power and Control Engineering
- ✓ Bachelor of Science Degree in Electronics and Communication Engineering
- ✓ Bachelor of Science Degree in Computer Engineering

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Courses and Competencies Identified for Exit Exam 2015 (First Draft)

1. Introduction

Electrical and Computer Engineers (ECE) design and implement devices, circuits and systems for electronic communication, computing, electrical power, control and related applications. Graduates of the Electrical and Computer Engineering program play key role in the development of the country.

The ECE curriculum focuses on broad-based training to provide flexibility of career choices and focused training to provide competence in particular electrical engineering profession. It finds balance between breadth and depth to provide a solid foundation in the basic engineering, mathematics, electrical engineering on one hand, and comprehensive training in humanities and management on the other.

- The freshman courses are developed nationally by MoE.
- In the third semester students will join the pre-engineering program.
- In the four consecutive semesters, after pre-engineering, all the students take courses mainly in the core electrical engineering module.
- In the final three semesters, students are given the opportunity to focus on one of the five areas, namely communication engineering, electrical power engineering, computer engineering, industrial control engineering and microelectronics engineering.

In Ethiopia Higher Education Institutions (HEIs), in general, and the engineering education in particular, have embarked on major reform since the last decade. Notable in this regard is the capability building in the Engineering Capacity Building Program (ECBP) program, which was initiated in 2006.

Since 2012, the Ministry of Education (MoE) through one of its wings, Higher Education Strategic Center (HESC), has initiated to have modularized curricula in all programs in HEIs and to harmonize a program among institutes offering the same program.

As of 2014 the Ministry of Education has planned to implement university exit exam to start from 2015 E.C. As part of this effort, this document was prepared during the workshop prepared by MoE between July 18 – 19, 2022 in Bishoftu, Ethiopia. The draft document was then validated in a national workshop organized on August 09-10, 2022 at Addis Ababa Institute of

Technology, Addis Ababa University. This document outlines competencies and courses that can evaluate the student in key skills and knowledge upon completion of the program.

To come up with the electrical and computer engineering competency and course list for university exit examination, key graduate profiles of electrical and computer engineers were first selected from relevant curriculum. Based on the identified graduate profiles, competency and learning outcomes were identified. After this, courses were selected that can evaluate the identified competency and learning outcomes. And finally, the courses were categorized into themes.

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2. Expected profiles of graduates

Electrical and Computer Engineering is the branch of engineering that deals with the technology of electricity and electronics, especially the design and application of electronic circuit, equipment for power generation and distribution, machine control, communications and computer hardware and software. Graduates of this program are required to have the necessary competency to undertake these activities. The knowledge and skills expected are divided into basic skills, engineering knowledge and skills and specialization specific knowledge.

2.1. Basic skills

These represent the basic skills required for any graduate to work in a professional environment. Some of these skills are the following.

- Able to understand the state of art techniques, devices, software, protocols.
- Proceeding in methodical approach to solve problems.
- Working independently, assuming responsibility.
- Communicate effectively, in both written and orally, on complex electrical and computer engineering activities with a variety of audiences.
- Being a team member communicative, cooperative and transparent.
- Managing projects, productions, manpower and resources cost effectively.
- Recognize the personal, national and global needs for in the broadest context of technological dynamism.

2.2. Engineering knowledge and skill

These represent the engineering knowledge and skills required for any electrical and computer engineering graduate. Some of these skills are the following.

- Fundamental knowledge in engineering mathematics.
- Fundamental knowledge in physics, EM fields, semiconductors.
- Knowledge in electrical machines, electronic analogue and digital circuits, signal & system, measurements, control, microprocessor and communication.
- Design solutions for complex engineering problems and systems considering for public, health, safety, cultural, societal and environmental considerations.

- Conduct experiments, analyze and interpret results.
- Create, select and apply appropriate techniques, resources and modern engineering and ICT tools to complex electrical and computer engineering problems.
- Knowledge in computer hardware and software.

2.3. Profiles for streams (thematic areas)

The following streams (focus areas) of Electrical and Computer Engineering are identified as very important for development of the country. A student selects one of these streams at later stage of his/her study and specializes in the area.

2.3.1. Communication engineer

- Analyze, design and implement modern communication equipment and systems.
- Manage and upgrade communication/telecommunication industries.

2.3.2. Electrical power engineer

- Analyze and design electric power systems.
- Participate in the assessment and development of renewable energy technologies for the national grid expansion as well as rural electrification efforts.
- Analyze and design protection systems for electrical and mechanical systems.

2.3.3. Industrial control engineer

- Analyze, design and implement industrial control equipment and instrumentation.
- Analyze and design microprocessor based control systems and algorithms.

2.3.4. Computer engineer

- Analyze, design and implement computer hardware and software systems and applications.
- Integrating and administering hardware and software systems.

2.3.5. Electronics engineer

- Analyze, design, develop, produce and test electronic systems.

2.3.6. Electronic and Communication engineer

- Analyze, design and implement modern communication equipment and systems.

- Produce and test electronics system for various application.

2.3.7. Electrical power and control engineer

- Analyze and design electric power systems.
- Analyze, design and implement industrial control equipment and instrumentation.
- Analyze and design protection systems for electrical and mechanical systems.

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3. Competencies and learning outcomes

The competencies and learning outcomes envisaged to be evaluated by the university exit exam of electrical and computer engineering are categorized into core electrical engineering and specialization specific competencies.

3.1. Core electrical engineering competency

This competency is the heart of the program, which provides foundation for the electrical and computer engineering. The core learning outcomes are the following.

- Knowledge and skill
 - Analyze
 - Fundamental concepts of signals, systems and electrical and electronic engineering.
 - Digital logic design and programming.

3.2. Knowledge and skill in specialization specific competency

This competency is specific to the five specializations of the electrical and computer engineering disciplines. A prospective graduate is expected to have competency of one of the following specializations.

3.2.1. Communication engineering competency

- To analyze, design and implement modern communication equipment and systems.

3.2.2. Electrical power engineering competency

- To analyze, design and implement electric power systems.

3.2.3. Computer engineering competency

- To analyze, design and implement computer hardware and software systems and applications.

3.2.4. Industrial control engineering competency

- To analyze, design and implement modern industrial control system, equipment and instrumentation.

3.2.5. Microelectronics engineering competency

- Analyze, design, develop, produce and test electronic systems for various applications.

3.2.6. Electrical power and control engineering competency

- To analyze, design and implement electric power and control systems.

3.2.7. Electronic and Communication engineering competency

- To analyze, design and implement electronic and communication equipment and systems.

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4. Selected courses to be included in the exam

Electrical and Computer Engineering students take 60 – 65 courses and it is unrealistic to try and evaluate the student competency of all these courses by just one university exit examination. Therefore, only 13 courses are selected that can evaluate the competency of the student in key skills and knowledge that are identified in the competency and learning outcome section. It should also be noted that the questions from the selected courses should focus on long term knowledge and transferrable skills by taking into account the open book theme of professional practice. These courses are selected from core courses that are common to all and specialization (thematic area) courses.

The specializations (thematic areas) are given at different universities in forms of specialization or programs. To account for all these specialization and programs, the following specializations have been identified. A student will take an examination questions from the seven (7) common core courses and questions from the six (6) courses from student's thematic area.

4.1. Core courses common to all specializations

The following courses were selected to evaluate the core electrical and computer engineering competency.

- Fundamental of Electrical Engineering (Circuit) – 5 ECTS
- Computer programming (Introduction to Computing) – 5 ECTS
- Applied Electronics I (Electronic circuit I) – 5 ECTS
- Signals and System Analysis – 5 ECTS
- Digital logic design – 5 ECTS
- Network analysis and synthesis – 5 ECTS
- Entrepreneurship – 4 ECTS

4.2. Specialization specific courses

These courses are specific to each of the five specializations and a prospective graduate is expected to have competency in one of these five specializations.

4.2.1. Computer engineering specialization

- Object oriented programming – 5 ECTS
- Computer architecture and organization – 5 ECTS

- Microcomputers and Interfacing – 5 ECTS
- Data Communication and Computer Networks – 5 ECTS
- Embedded Systems – 5 ECTS
- Data structure – 5

4.2.2. Electrical power engineering specialization

- Introduction to Power Systems – 5 ECTS
- Electrical Machines – 5 ECTS
- Power Electronics – 5 ECTS
- Electrical Installation – 5 ECTS
- Energy Conversion and Rural Electrification – 5 ECTS
- Power System Protection and Control – 5 ECTS

4.2.3. Electronic communication engineering specialization

- Introduction to Communication Systems – 5 ECTS
- Communication systems (Digital communication) – 5 ECTS
- Data Communication and Computer Networks – 5 ECTS
- Telecommunication Networks – 5 ECTS
- Antennas and Radio Wave Propagation – 5 ECTS
- Wireless and Mobile Communication – 5 ECTS

4.2.4. Industrial control engineering specialization

- Introduction to Control Engineering – 5 ECTS
- Introduction to Instrumentation – 5 ECTS
- Electrical Machines – 5 ECTS
- Modern Control Systems – 5 ECTS
- Electrical Installation – 5 ECTS
- Power Electronics and Drives – 5 ECTS

4.2.5. Electronics engineering specialization

- Computer architecture and organization – 5 ECTS
- Principles of Electronic Design – 5 ECTS
- Microelectronic Devices and Circuits – 5 ECTS

- Microcomputers and Interfacing – 5 ECTS
- VLSI Design – 5 ECTS
- Integrated circuit technology – 5 ECTS

4.2.6. Electronics and communication engineering (ASTU)

- Introduction to Communication Systems – 5 ECTS
- Communication systems (Digital communication)– 5 ECTS
- Computer architecture and organization - 5
- Antennas and Radio Wave Propagation – 5 ECTS
- Wireless and Mobile Communication – 5 ECTS
- Microcomputers and Interfacing – 5 ECTS

4.2.7. Electrical power and control engineering (ASTU)

- Electrical Machines – 5 ECTS
- Introduction to Power Systems – 5 ECTS
- Electrical design for building – 5 ECTS
- Power System Protection and Control – 5 ECTS
- Introduction to Control Engineering – 5 ECTS
- Process Control fundamental– 5 ECTS

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5. Categorizing courses into themes

The courses are categorized according to the expected competencies of a prospective graduate of Electrical and Computer Engineering.

Course name	ECTS	Knowledge	Skill	Attitude	Theme
Fundamental of Electrical Engineering (Circuit)	5	✓		✓	Core
Computer programming (Introduction to Computing)	5	✓	✓	✓	Core
Applied Electronics I (Electronic circuit I)	5	✓	✓		Core
Signals and System Analysis	5	✓			Core
Digital logic design	5	✓	✓		Core
Network analysis and synthesis	5	✓	✓		Core
Entrepreneurship	4	✓	✓		Core
Object oriented programming	5	✓	✓		Computer Engineering
Computer architecture and organization	5	✓			Computer Engineering
Microcomputers and Interfacing	5	✓	✓		Computer Engineering
Data Communication and Computer Networks	5	✓	✓		Computer Engineering
Embedded Systems	5		✓		Computer Engineering
Data structure	5	✓			Computer Engineering
Introduction to Power Systems	5	✓	✓		Power Engineering
Electrical Machines	5	✓	✓	✓	Power Engineering
Power Electronics	5	✓	✓		Power Engineering
Electrical Installation	5	✓	✓	✓	Power Engineering
Energy Conversion and Rural Electrification	5	✓	✓	✓	Power Engineering
Power System Protection and Control	5	✓	✓	✓	Power Engineering
Introduction to Communication Systems	5	✓	✓		Communication Engineering
Communication systems (Digital communication)	5	✓	✓		Communication Engineering
Telecommunication Networks	5	✓	✓	✓	Communication Engineering
Antennas and Radio Wave Propagation	5	✓	✓		Communication Engineering
Wireless and Mobile Communication	5	✓	✓		Communication Engineering
Introduction to Control Engineering	5	✓	✓		Control Engineering
Introduction to Instrumentation	5	✓	✓		Control Engineering
Modern Control Systems	5	✓	✓		Control Engineering

Power Electronics and Drives	5	✓	✓		Power Engineering
Principles of Electronic Design	5	✓	✓		Electronics Engineering
Microelectronic Devices and Circuits	5	✓	✓		Electronics Engineering
VLSI Design	5	✓	✓		Electronics Engineering
Integrated circuit technology	5	✓	✓		Electronics Engineering
Electrical design for building	5	✓	✓	✓	Power Engineering
Process Control fundamental	5	✓	✓		Control Engineering

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6. Conclusion

In conclusion, based on identified graduate profiles, competencies and learning outcomes 13 courses were selected to evaluate the competency of Electrical and Computer Engineering graduates. This draft competencies and list of courses for university exit exam for electrical and computer engineering should be reviewed and discussed with all the other universities and stakeholders.

The list of courses may be updated based on curriculum revision if there is an addition or removal of courses from the identified set of courses.

For successful competency evaluation of the students the following key points should be taken into account.

- The examination questions should focus on key knowledge of each specific course instead of detailed assessment that has already been undertaken in their course work.
- The examination questions should focus on long-term knowledge and transferrable skill.
- It should also take into account the student ECTS load during graduation time.
- The timing and administration of the competency examination should not be a hindrance for timely graduation.

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