

**Ministry of Education**

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

Program: - Bachelor of **Science and Education** in **PHYSICS**

Animal Sciences Graduates To Be Held In 2015 E.C

Competencies & Courses Suggested For Exit Examination For Bsc In

Animal Sciences Graduates To Be Held In 2015 E.C

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# **Introduction**

Physics, as one of the fundamental sciences, is concerned with the observation, understanding and prediction of natural phenomena and the behavior of man-made systems. It deals with profound questions about the nature of the universe and with some of the most important practical, environmental and technological issues of our time. The scope of Physics is broad and encompasses mathematical and theoretical investigations, experimental observations, computing techniques, technological applications, and material manipulations. Physics seeks simple explanations of physical phenomena based on universal principles stated in concise and powerful language of mathematics. The principles form a coherent unity, applicable to objects as diverse as DNA molecules, neutron stars, super-ﬂuids, and liquid crystals. Discoveries in Physics have implications in all walks of life ranging from the way we perceive reality to gadgets of everyday use. Physicists constantly test the basic laws of nature by probing the unknown, the mysterious and the complex. They also search for new laws at the frontiers of knowledge, systematically seek

novel properties of matter.

In principle the current educational trends emphasize graduate profiles (attributes, knowledge and skills) that enable students keep abreast of the progress in science and technology, and utilize their knowledge and skills to solve real-physical problems. Based on this the graduates are expected to fulfill the minimum learning competency and considerable learning outcomes. Therefore as per the guideline given by MOE the graduates are expected to take an exit exam as of 2015 E.C. Thus, we have proposed 13 physics courses from which the question for the exit exam will be prepared. We selected these 13 physics courses from 29 compulsory physics courses in the BSc program and 20 compulsory physics courses in the BEd program by taking the courses that are common for both programs.

# **Expected profiles of graduates**

The Physics graduates are expected to acquire problem solving and abstract thinking skills. This makes Physics graduates desirable professionals for various services and career over a wide range of science and technology innovation, development, critical thinking and decision making, modeling, constructing laws, tracing laws and principles of natural laws to explain phenomena over a wide range of systems (from very small to very large system) including new discoveries and explorations. The graduates are expected to apply the knowledge and skill they obtained on new Science and Technology applications and reforms for overall socio-economic development of the community. Furthermore, graduates will have basic knowledge and skills in teaching physics courses which will enable them to teach in senior secondary schools and higher learning institutions.

# **Competencies and learning outcomes**

|  |  |  |
| --- | --- | --- |
| Theme | Minimum learning competencies | Learning outcomes |
| 1.1 Mechanics (4 Chrs.) | * Will acquire basic knowledge in mechanics * Will acquire basic problem solving skills in mechanics | Graduates will be able to:   * compute kinematical and dynamical related problem in 1D, 2D, and 3D. * solve problems related to work and energy. * calculate problems related to energy and momentum conservation. * solve problems relates to simple harmonic motion. |
| 1.2: Fluid and thermal physics (3 Chrs) | * Will acquire basic knowledge in Fluid and thermal physics * Will acquire fundamental skills in Fluid and thermal physics | Graduates will be able to:   * explain und understand basic principles of fluid dynamics. * comprehend the concept of temperature and heat to compute thermal expansion of solids and fluids * understand the kinetic theory of gases and laws of thermodynamics * measure temperature and heat quantities. |
| 1.2: Classical mechanics  (3 Chrs.) | * Will acquire basic knowledge in   classical mechanics   * Will acquire problem solving skills in classical mechanics | graduates will be able to:   * relate motions in different coordinate systems, * obtain the velocity, acceleration and momentum in generalized coordinate, * develop the capability to determine the Lagrangian and Hamiltonian of mechanical systems. |
| 1.4 Fundamental astronomy (3 Chrs.) | * Will acquire basic knowledge in understanding and explaining the fundamental concepts of astronomy * Will develop attitude of being astronomer. | Graduates will be able to:   * describe the features of objects in the Solar System * demonstrate and understand the basic properties of the Sun and other stars * explain stellar evolution, including red giants, supernovas, neutron stars, pulsars, white dwarfs and black holes. |
| 2.1 Electromagnetism  (4 Chrs.) | * Will acquire basic knowledge in Electromagnetism * Will acquire problem solving skills in Electromagnetism * Will acquire skills in constructing electrical circuits | Graduates will be able to:   * explain the basic concepts of electric charge, electric field and electric potential and solve problems related to these concepts * solve problems related to electric circuits containing electrical elements (resistors, capacitors, inductors …) * understand Maxwell’s equation in free space and media and solve problems related to Maxwell’s equations * construct different types of electric circuits. |
| 2.2 Waves and optics (3 Chrs.) | * Will acquire basic knowledge in Waves and optics * Will acquire problem solving skills in Waves and optics * Will acquire skills in constructing devices (pin hole camera, periscope, telescope)   , | Graduates will be able to:   * describe basic laws and principles of mechanical and electromagnetic waves * calculate and derive equations of amplitude, wave energy and intensity * understand the geometrical description of different properties of light (reflection and refraction of light) * design and construct simple optical devices, |
| 2.3 Electrodynamics I  (3 Chrs.) | * Will acquire basic knowledge in Electrodynamics * Will acquire problem solving skills in Electrodynamics | Graduates will be able to:   * solve different problems in electrodynamics, by applying different techniques. * understand and solve boundary value problems in electrodynamics, * comprehend electric circuits containing electrical elements (resistors, capacitors, inductors) * understand Maxwell’s equation in free space and media and solve problems related to Maxwell’s equations. |
| * 1. Modern Physics   (3 Chrs.) | * Will acquire basic knowledge in Modern Physics * Will acquire problem solving skills to problems related to Modern Physics | Graduates will be able to:   * apply the theory of Special Relativity to solve problems related to time dilation, length contraction, simultaneity, relativistic momentum, and relativistic energy. * apply quantum methods to solve problems involving atomic spectra, blackbody radiation, the photoelectric effect, X-ray emission and the structure of the atom. |
| * 1. Quantum mechanics I   (3 Chrs.) | * Will acquire basic knowledge in Quantum mechanics * Will acquire fundamental skills of solving problem related to Quantum mechanics | Graduates will be able to:   * explain, compare and contrast the wave-particle characteristic of electromagnetic waves * elaborate the central concepts and principles of quantum mechanics * analyze the difference between the classical wave equation and the Schrödinger wave equation to describe a physical systems. |
| * 1. Nuclear physics   (3 Chrs.) | * Will acquire basic knowledge in Nuclear physics * Will acquire fundamental skills of solving problems related to Nuclear physics | Graduates will be able to:   * explain the key properties of nucleus in relation to the stipulated theoretical framework. * identify the excitation and ground state of a particle that may happen in the nucleus of an atom. * solve problems related to nuclear binding energy, fusion and fission or nuclear reaction. |
| 4.1 Statistical physics  (3 Chrs.) | * Will acquire basic knowledge in Statistical physics * Will acquire fundamental skills of solving problems related to Statistical physics | Graduates will be able to:   * understand microscopic and macroscopic systems and processes, * apply basic statistical concepts required to describe physical systems for obtaining various mean values * identify Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics in describing a given system. |
| 4.2 Solid state physics  (3 Chrs.) | * Will acquire basic knowledge in Solid state physics * Will acquire fundamental skills of solving problems related to Solid state physics | Graduates will be able to:   * understand Crystal Structure and X-ray Diffraction, * explain vibration in mono and diatomic molecules and solids, * solve problems related to free electron theory, properties of metals; Fermi surfaces; Kronig-Penny model, and energy bands. |
| 4.3 Electronics  (3 Chrs.) | * Will acquire basic knowledge in Electronics * Will acquire basic skills that enables him/her to design simple electronic devices | Graduates will be able to:   * understand charge carrier generation in intrinsic and extrinsic semi-conductors; * explain various types of diodes, IV characterestics of diodes and some application of diodes as recetifier. * analyze the basic principles of bipolar junction transistor (BJT) circuit in various configuration (common emitter, common base and common collector) * construct simple electronic devices |

# **Physics courses to be included in the exit exam**

1. Mechanics
2. Fluid and thermal physics
3. Electromagnetism
4. Modern Physics
5. Waves and optics
6. Nuclear physics
7. Electronics
8. Quant mechanics I
9. Electrodynamics I
10. Classical mechanics
11. Statistical physics
12. Solid state physics
13. Fundamental astronomy

# **Categorization physics courses into themes**

**Theme 1: Classical Physics**

* 1. Mechanics
  2. Fluid and thermal physics
  3. Classical mechanics
  4. Fundamental astronomy

**Theme 2 Electromagnetic theory**

2.1 Electromagnetism

* 1. Waves and optics
  2. Electrodynamics I

**Theme 3: Quantum physics**

* 1. Modern Physics
  2. Quantum mechanics I
  3. Nuclear physics

**Theme 4: Condensed matter physics**

* 1. Statistical physics
  2. Solid state physics
  3. Electronics

# **Conclusion**

As it is well known there is a great intension to improve the graduate profiles of the BSc and Bed Physics graduates so as to meet the required demand of the country. A strong background in Physics is necessary for careers in quality education, industry and energy sector. Thus, it is imperative that students be equipped with strong Physics knowledge, skills and attitudes which enable them to be productive and capable. In line with this, in order to qualify the knowledge, skills, and attitudes of the graduates with respect to the BSc and BEd curricula 13 compulsory physics courses are selected for the anticipated national exit examination. This proposed guideline is expected to be amended/ commented by all government universities whose students will take the exit exam.

**Remark**

**Finally, since the BEd graduates take significant number of professional (Education) courses as compulsory courses, we propose a separate exit exam be prepared which incorporates the professional courses that they have taken.**