INTRODUCTORY ATOMIC PHYSICS, HEAT AND OPTICS

CONTEXT

Physics has often been viewed as a difficult subject, and this is an attitude that is engendered by teachers who were not well taught themselves and who are only teaching physics because there is no-one else to do it. The subject is therefore often taught without enthusiasm, together with “dry” content. The curriculum itself doesn’t help as it is often not well thought through and much of what we teach in high school is foundational for higher level courses. This means that the more interesting material is often deemed to be too conceptually difficult, especially by those whose main subject interest is chemistry or biology. There are many students in our classes who are doing physics as a means to get into engineering or medical courses. This may be one of the reasons why there is a lack of students studying for science degrees and becoming teachers. If we are to change the downward spiral, we must enable students to see the excitement in physics – the wonder and the amazing possibilities of being able to see how the universe works. Women are underrepresented in science, especially in physics education. Most leakage from the STEM career “pipeline” occurs in high school and in the transition from high school to college, not in college. Most students who do not/cannot take high school physics never enter the pipeline. Engaging, well-prepared physics teachers are critical to providing capable students and especially women with the confidence and interest to pursue STEM degree programs. Poor initial physics experiences can dissuade and demoralize. Highly qualified physics teachers tend to be hired by established boarding schools our big cities, not by districts in our inner cities and rural areas. Inequality of opportunity in physics education contributes to inequality in college and career outcomes. In this course, assessment techniques and pedagogical practices that improve women and girls’ knowledge, attitude and participation in science would be employed.

Course Title	Introductory Atomic Physics, Heat and Optics							
Course Code	EBS 357	Course Level:	300	Credit Value:	3	Semester	1	
Pre-requisite	General Physics Theory I & II							
Course Delivery Modes	Face -to -face [1] ☑	Practical Activity [2] ☐	Work-Based e-Learning [3] ☑	Seminars [4] ☐	Independent Study [5] ☑	learning opportunities [6] ☑	Practicum [7] ☐	

Course Description for significant learning (indicate NTS, NTECF, BSC	This course is meant to initiate the students to three of the important themes in physics. The atomic physics section introduces student to the study of the structure of the atom as an isolated system of electrons and nucleus, its energy states and interactions with other particles and with electric and magnetic fields. From childhood on, we learn that atoms are a substructure of all things around us, from the air we breathe to the autumn leaves that blanket a forest trail.

GLE to be addressed)	Invisible to the eye, the existence and properties of atoms are used to explain many phenomena. In this course, we discuss the discovery of atoms and their own substructures; we then apply quantum mechanics to the description of atoms, and their properties and interactions. Along the way, students will find, much like the scientists who made the original discoveries that new concepts emerge with applications far beyond the boundaries of atomic physics. The heat aspect introduces students mainly to heat conduction and the first and second laws of thermodynamics. Energy can exist in many forms and heat is one of the most intriguing. Heat is often hidden, as it only exists when in transit, and is transferred by a number of distinctly different methods. Heat transfer touches every aspect of our lives and helps us understand how the universe functions. It explains the chill we feel on a clear breezy night, or why Earth's core has yet to cool. The optics is designed to initiate the student to the branch of physics which involves the behavior and properties of light including its interaction with matter. It considers light interference, detraction and detraction gratings. (NTS 2b, 2c, p13; 3e-3m; 3p, p14; NTECF Pillar 1)	
Course Learning Outcomes [8]: including INDICATORS for each learning outcome	Outcomes: Upon successful completion of the course, learners will be able to:	Indicators
	1. Demonstrate an understanding of the study of the structure of the atom as an isolated system of electrons and nucleus, its energy states and interactions with other particles and with electric and magnetic fields. (NTS 2b, 2c, p13, 3f, 3g, 3h, 3i, 3j, p14)	• Design a nuclear model of the atom, in which the atom is pictured as a miniature solar system to explain Rutherford and Bohr's nuclear model of the atom. • Use Coulomb's law to estimate the size of the nucleus.

	2. Describe how electrons were discovered and explain the Millikan oil drop experiment. (NST 2b, 2c, p13, 3i 3g, 3j, 3m, p14)	• Design Millikan's Oil Drop Experiment to determine the size of the charge on an electron. • Put a charge on a tiny drop of oil, and measure how strong an applied electric field had to be in order to stop the oil drop from falling.
	3. Distinguish between the types of heat transfer, using the 1st and 2nd Laws of Thermodynamics. (NST 2b, 2c, p13, 3g, 3j, 3l 3m, p14)	• Illustrate the types of heat transfer using boiling of water in an basin, cooking of food in a microwave. • Using vacuum flask, describe 1st and 2nd Laws of Thermodynamics.

	4. Demonstrate an understanding of the basic idea of superposition of waves, explaining what happens when two or more waves meet (NST 2b, 2c, p13, 3g, 3j, 3m, p14)			• Design and show some images of ripples on a pool of water as they pass through each other.
Course Content	Units	Topics:	Sub-topics (if any):	Teaching and learning activities to achieve learning outcomes

	1.	Atomic physics	• Dalton and Proust Atomic theories • Thompson's atom model • Rutherford's nuclear atom model • Drawbacks of Rutherford's model • Hydrogen spectrum • Bohr's theory of atomic structure • Short comings of Bohr's atomic model • Spectrum of ionized Helium -Finite mass correction -X-ray tube and its characteristics -X-ray characteristics spectrum -The use of x-ray in medical observation and CT scanners in diagnostics	• Prepare a white light and a set of standard discharge lamps: sodium, neon, hydrogen and helium to demonstrate emission spectra. (This could also be done using a direct vision spectroscope or a bench spectroscope, or simply by holding a diffraction grating up to their eye. • Design a scale diagram of energy levels to unearth and explain the large energy drops between energy certain levels • Design a model of the nuclear atom to explain Dalton, Thompson, Rutherford and Bohr's model of atom. • With the aid of diagram describe x-ray
	2.	Heart	• Conductivity • Thermodynamics (1st and 2nd Law) -Kinetic Theory of gases	• There are a number of possible demonstrations of the First Law. Simple and dramatic ones include commercial devices that let you compress a cylinder of air rapidly and ignite a small wad of cotton.

					• A more conventional alternative is to compress the air in a bicycle pump and to observe the rise in temperature
	3.	Physical Optics	• Introduction – Interference and Coherent sources • Two-source interference of light – constructive and destructive • Two-slit interference intensity in interference • Interference in thin films • Diffraction from a single slit • Multiple slits -Diffraction Grating		• Shine a laser through a piece of cloth or a slit and observe the waves spread or the multiple spots of light that would be shown on the screen. • Drop a pebble into a bowl of water and observe the ripples.

Course Assessment Components[9] : (Educative assessment of, for and as learning)	A combination of formative and summative assessment including group tasks, quizzes and examination will be used. Assessment weighting: Component 1: Formative assessment Quiz 1 (CLO 1) 10% Quiz 2 (CLO 2) 10% Group tasks (CLO 3) 20% Component 2: Summative assessment CLO 1-3. 60% Students will be graded as follows: **A**=80-100%; **B+=**75-79%; **B** =70-74%, C+ =65-69%, **C=** 60-64%, **D+=**55-59, **D=**50-54, **E<** 50 (Fail)
Instructional Resources	Computer assisted instruction, Interactive simulations, Smart phones, Google, YouTube, PowerPoint Projections
Required Text (core)	Hecht, E. (2008). *Optics* (4th ed.). Pearson Addison Wesley Blundell, S. J. & Blundell, K. M. (2009). *Concepts in Thermal Physics*. Oxford University Press Pedrotti, F. L. (2003). *Introduction to Optics* (3rd ed.). Prentice Hall Inc.
Additional Reading List 10	Jewett, J.W. & Sarway, R. A. (2002). *Principles of physics*. (3rd ed.) Harcourt College publishers. Resrucr, R., Halliday, D., & Walker, J. (2010). *Fundamentals of physics.* John Wiley & Sons Inc.