Course Title:	**Physics I :** **MECHANICS, THERMODYNAMICS, AND ATOMIC PHYSICS**
Head of Department:	Nadia Iskandarani
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Cycle/Division:	High School
Grade Level:	Grade 11
Credit Unit:	1
Duration:	2 semesters / 5 periods per week

Department's Vision:	Create Innovators who can link to life, with scientific understanding and learning.
Department's Mission:	Provide students with the proper knowledge, skills and scientific principles through hands on activities, research and experimentations, and thus creating young innovators who are ready for real life challenges and problem solving.

COURSE DESCRIPTION:

This course introduces Kinematics, Newton's laws, the laws of thermodynamics, elements of atomic, nuclear and particle physics, energy and momentum conservation, rotational motion, and angular momentum conservation, one and two dimension motion, work and power. The laboratory work is based on research and application with a term lab theoretical and practical assessment.

General Academic Goals:

Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
Measure, calculate, and graph the speed of an object's position as a function of time. Describe the motion of an object by its position and velocity as functions of time and by its average speed and average acceleration during intervals of time.
Study basic Forces in Nature Objects can interact with each other by "direct contact" (e.g., pushes or pulls, friction) or at a distance (e.g., gravity, electromagnetism, nuclear). Calculate net Forces specifying magnitude and direction and applying Newton's First Law.
Apply Newton's Third Law.
Understand forces and acceleration as a change of speed happens.
Understand energy Transformation and study specifically energy converted to thermal energy.
Understand, analyze, and relate Kinetic and Potential Energy.
Understand nuclear Reactions and the related changes in atomic nuclei that can occur through three processes: fission, fusion, and radioactive decay.
Understand radioactive decay that occurs naturally in the Earth's crust (rocks, minerals) and can be used in technological applications (e.g., medical diagnosis and treatment).

General Skills:

Evaluation skills: making judgment about knowledge by introducing new text to solve and tackle problems using the related knowledge taught.
Comprehension: given scientific text or diagrams to analyze and answer questions about, summarize, compare, relate, or experiment...
Communication and social skills: Making movies, ppt., projects, interviews, and presenting the work either individually or with a peer or as a group.
Investigative skills: lab work, research, journals, experimentation...
Mathematical skills: related to investigations in the lab and application in projects.
Technological skills used in science and computer labs.
Knowledge skills: list, define, show, demonstrate, invent, relate etc… using the taught concepts.

GENERAL COURSE LEARNING OBJECTIVES:

List basic units and quantity they describe.
Use scientific notation when taking measurements and consider accuracy, precision and significant figures.
Understand the motion of freely falling object
Understand vector notation and apply vector calculations.
Use graphical method, vector notation and other geometrical applications to find the resultant vector of a group of vectors.
Consider an object's motion (horizontal, vertical and projectile) in terms of classical mechanics. Apply kinematics equations to calculate motion parameters.

Understand and apply Newton's laws to study different kinds of forces and use examples of everyday life forces.
Understand and apply concepts of work, energy, power and laws of conservation of energy.
Understand and apply concepts of momentum, impulse and collisions (elastic and inelastic).
Understand rotational motion and relate radians to degrees.
Calculate the angular displacement using the arc length and distance from the axis of rotation.
Calculate angular speed and angular acceleration and solve problems using the kinematics equations for rotational motion.
Find the tangential speed of a point on a rigid rotating object using angular speed and the radius.
Solve problems involving tangential and centripetal accelerations.
Calculate the force that maintains circular motion.
Apply Newton's universal law of gravitation to find the gravitational force between two masses.
Recognize the difference between a point mass and an extended object.
Distinguish between torque and force.
Calculate the magnitude of a torque on an object.
Identify the lever arm associated with a torque on an object.
Identify the center of mass of an object.
Distinguish between mass and moment of inertia.
Define the condition of equilibrium and solve problems involving the first and the second conditions of equilibrium.
Understand the Newton's second law for rotation.
Calculate the angular momentum for various rotating objects.
Solve problems involving rotational kinetic energy.
Identify the six types of simple machines.
Calculate the mechanical advantage and the efficiency of a simple machine.
Identify the properties of the nucleus of an atom.
Explain why some nuclei are unstable.
Calculate the binding energy of various nuclei.
Describe the three modes of nuclear decay.
Predict the products of nuclear decay.
Calculate the decay constant and the half-life of a radioactive substance.
Distinguish between nuclear fission and nuclear fusion.
Explain how a chain reaction is utilized by nuclear reactors.

Compare fission and fusion reactors.

Define the four fundamental interactions of nature.

Identify the elementary particles that make up matter.

Describe the standard model of the universe

STANDARDS/BENCHMARKS:

Energy

HS-PS3-1 Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-2 Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).

HS-PS3-3 Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*

HS-PS3-4 Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

Forces and Interactions

HS-PS2-1 Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

HS-PS2-2 Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.

HS-PS2-3 Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*

HS-PS2-4 Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

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Engineering Design

HS-ETS1-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

HS-ETS1-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

RESOURCES:

HOLT Physics book and online resources
One Stop Planner, Linked Lesson presentations, Extended Visual Labs
You Tube movies
E-games and links
Teacher's Extended Handouts
Lab Handouts

COURSE OUTLINE:

Chapter 1: The Science of Physics

Section 1: What is physics?
Section 2: Measurements in experiments
Section 3: The Language of physics

Chapter 2: Motion in One Dimension

Section 1: Displacement and Velocity
Section 2: Acceleration
Section 3: Falling Objects

Chapter 3: Two-Dimensional Motion and Vectors

Section 1: Introduction to vectors
Section 2: Vector Operations
Section 3: Projectile Motion
Section 4: Relative Motion

Chapter 4: Forces and the Laws of Motion

Section 1: Changes in Motion
Section 2: Newton's First Law
Section 3: Newton's second and third Laws
Section 4: Everyday forces

Chapter 5: Work and Energy

Section 1: Work
Section 2: Energy
Section 3: Conservation of energy
Section 4: Power

Chapter 6: Momentum and Collisions

Section 1: Momentum and Impulse
Section 2: Conservation of momentum
Section 3: Elastic and Inelastic Collisions

Chapter 7: Circular Motion and Gravitation

Section 1: Circular Motion
Section 2: Newton's Law of Universal Gravitation
Section 3: Motion in Space
Section 4: Torque and Simple Machines

Chapter 10: Thermodynamics

Section 1: Relationships between Heat and Work
Section 2: The first Law of Thermodynamics
Section 3: The Second Law of Thermodynamics

Chapter 11: Vibrations and Waves

Section 1: Simple harmonic motion
Section 2: Measuring simple harmonic motion
Section 3: Properties of waves
Section 4: Waves interactions

GRADING:

1. Quizzes /tests are given every other week as assigned by school. **Our tests and assessments** consist of multiple-choice, short answer, direct application problems, critical thinking situations, refer to figures, texts, graphs and/or open response items. They are aligned with Michigan benchmarks. A student failing any of his quizzes would have to sit for a **support class and retest** to achieve his 60% which is our passing mark. **A progress report is sent to the parent eventually after sitting for the make up exam.** 40 % is given to students that do not have a medical excuse for missing such an assessment.

2.Skill Based Assignments are done in class where a student has his resources all opened in front of him to answer a set of questions under verbal, nonverbal, quantitative, and spatial domains.

3. Research Sessions are done where students can debate as groups and check the internet for resources and answers to support their ideas. This kind of assessment is under **Research /Project/ Lab Sessions /Journals**. They are evaluated to info, creativity, presentation, discussion and relation to the subject.

4.Daily assessments and drop quizzes take place to check the understanding of students.
5. Laboratory work is checked for research, completeness, accuracy, understanding the experiment, group and individual reports and attendance with the lab coats. Every semester has one term practical assessment.

7. Projects are integrated across and assigned for every term. They are evaluated to accuracy, creativity, info and relation to the subject.

Grade Distribution:

SCIENCE DEPARTMENT GRADE DISTRIBUTION	
HIGH SCHOOL	
End of semester assessment	30%
Quizzes	30%
Skill based Assessment	5%
Project	10%
Research/Journal	5%
Labs	10%
MAP	5%
Drop Quizzes	5%

Cross-Curricular Project(s):

- Once per semester across disciplines.