Republic of Rwanda
Ministry of Education

RTB | RWANDA TVET BOARD

APPLIED PHYSICS

GENGP302 Apply General Physics

Competence

RQF Level: 3

Learning Hours 40

Credits: 4

Sector: ALL SECTORS EXCEPT HOSPITALITY AND TOURISM

Trade: ALL trades except (Fashion design, Fine and Plastic Arts, Agriculture, Food Processing, Animal Health, Forestry, Leather Technology, Food and Beverages Operations, Front Office and Housekeeping operations, Tourism)

Module Type: General

Curriculum: GENGP302-TVET - ALL SECTORS EXCEPT HOSPITALITY

Issue Date: May 2023

Purpose statement	This module describes the knowledge, skills, and attitude required to apply concepts of physics. At the end of this module, the learner will be able to describe basic measurements in physics, analyze motion in one and two dimensions, demonstrate electrostatic phenomena, apply geometric optics and characterize sources of energy in the world. It will help trainee to carry out his/her specialized tasks that are useful in analyzing data, solving real life problems encountered in related fields.

Delivery modality	**Training delivery**		**100%**	**Assessment**		**Total 100%**
	Theoretical content		30%	Formative assessment	30%	50%
	Practical work:		70%		70%	
	• Group project and presentation	20%				
	• Individual project /Work	50%				
				Summative Assessment		50%

Elements of Competency and Performance Criteria

Elements of competency	Performance criteria	
1. Describe basic measurements in physics	1.1.	Physics quantities are clearly derived based on dimension analysis
	1.2.	Experimental errors are accurately calculated based on their types
	1.3.	Measuring instruments are properly used based on metric system
2. Describe Motion in 1- Dimension	2.1.	Displacement, velocity and acceleration concepts are clearly explained in 1 dimension
	2.2.	Linear motion concepts are clearly illustrated based on their corresponding graphs
	2.3.	Equations of motion are appropriately applied in a straight line under constant acceleration
3. Analyze motion in Two Dimensions	3.1.	Scalars, vectors and vector components are clearly described in Cartesian coordinate system
	3.2.	Displacement, velocity and acceleration concepts are clearly Illustrated in 2 dimensions
	3.3.	Motion is clearly described in two dimensions
4. Demonstrate electrostatic phenomena	4.1.	Electrostatic charges and their conservation are correctly described in line with laws of static charges on Coulomb's law
	4.2.	Electrostatic fields are effectively determined based on Coulomb's law
	4.3.	Effects of electric field on charged particles are clearly demonstrated based on fundamental laws of static charges
	5.1.	Properties of light are properly explained based on homogenous medium

5. Apply Geometric optics	5.2.	Reflection of light on surfaces is effectively applied based on laws of reflection
	5.3.	Refraction of light in different media is effectively applied based on Snell's law
6. Characterize sources of energy in the world	6.1.	Basic concepts of work, energy and power are properly explained based on the corresponding physical meanings.
	6.2.	Types of energy are properly identified based on their sources
	6.3.	Relative advantages and disadvantages of various energy sources are properly analyzed according to the sources

Course content

Learning outcomes	**At the end of the module the learner will be able to:**
	1. Describe basic measurements in physics 2. Describe Motion in 1- Dimension 3. Analyze motion in Two Dimensions 4. Demonstrate electrostatic phenomena 5. Apply Geometric optics 6. Characterize sources of energy in the world

Learning outcome 1: Describe basic measurements in physics	**Learning hours: 8**
Indicative content	

- ***Derivation of physical quantities***

✓ Meaning of fundamental physical Quantities
- Mass
- Length
- Time

✓ Meaning of derived physical quantities
- Volume
- Weight
- Density
- Area
- Force

✓ International system of units (SI) and metric prefixes in everyday use
- Name, symbol and factor

✓ Dimension analysis
- Definition of dimensions of physical quantities
- Assigning dimensions to physical quantities
- Rules of writing dimensions of physical quantities
- Benefits of dimensions
- Limitation of dimensions.

- ***Calculation of experimental errors***

✓ Types of experimental errors
- Definition of experimental error
- Systematic error
- Random error
- Absolute errors
- Relative errors
- Percentage error

✓ Rules of identifying significant digits
- Examples on applying rules of significant figures
- Rounding off numbers

- ***Using measuring instruments at workplace.***

✓ Measuring instruments used to measure length
✓ Measuring instruments used to measure mass
✓ Measuring instruments used to measure time

Resources required for the learning outcome	
Equipment	PPE, Whiteboard and chalkboard
Materials	Chalks, Markers, Flipchart
Tools	Computer, Projector, Various measuring instruments, Textbooks, Scientific calculator
Facilitation techniques	• Demonstration and simulation • Individual and group work • Practical exercise • Trainer guided • Group discussion
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Product based assessment • Project based assessment

Learning outcome 2: Describe Motion in 1- Dimension	Learning hours: 5

Indicative content

- **Explanation of displacement, velocity and acceleration concepts**

✓ Displacement & distance
  - Point location on a line
  - Speed and velocity

✓ Description of Average & Instantaneous acceleration

- **Illustration of linear motion using corresponding graphs**

✓ Slopes and General Relationships
  - Definition of rise, run, slope, intercept and equation of a straight line

✓ Graph of displacement vs. time
  - Constant velocity
  - Constant acceleration
  - Non constant acceleration

✓ Graph of velocity vs. Time
  - With positive acceleration
  - With zero acceleration
  - With negative acceleration

- **Application of equations of motion**

✓ Velocity as a function of time
  - Initial velocity
  - Acceleration
  - time

✓ Displacement as a function of time
  - Relation between displacement and average velocity

✓ Final velocity as a function of displacement
  - Equation of velocity
  - Acceleration

✓ Analyze freely falling objects
  - Acceleration of Gravity
  - Representing Free Fall by Graphs

Resources required for the indicative content

Equipment	PPE, whiteboard, chalkboard, computer, projector, textbooks

Materials	Chalks, markers
Tools	Scientific calculator, meter ruler, compass
Facilitation techniques	• Demonstration and simulation • Individual and group work • Practical exercise • Trainer guided • Group discussion • Research
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Product based assessment • Project based assessment

Learning outcome 3: Analyze motion in two Dimensions	**Learning hours: 6**
Indicative content	

- **Description of scalars, vectors and vector components**

✓ Scalars
- Properties of scalars
- Operation on scalars

✓ Vectors
- Properties of vectors
- Vectors addition & subtraction

✓ Vector components in Cartesian coordinate system
- Point location in space
- position vector
- Components of the position vector.

- **Illustration of displacement, velocity and acceleration**

✓ Displacements in two dimensions
- Subtraction of vectors
- Change in position vector

✓ Velocity in two dimensions

- Average velocity
- Instantaneous velocity

✓ Acceleration in two dimensions
- Average acceleration
- Instantaneous acceleration

- **Description of motion**

✓ Motion in two dimensions
- Graphical representation
- Velocity components

✓ Projectile motion
- Definition of projectile motion
- Applications of projectile motion
- Projection angle

✓ Equations of motion
- vertical component
- Horizontal component

Resources required for the indicative content	
Equipment	PPE, whiteboard and chalkboard, computer, projector, textbooks
Materials	Chalks, markers
Tools	Scientific calculator, meter ruler, compass
Facilitation techniques	• Demonstration and simulation • Individual and group work • Practical exercise • Trainer guided • Group discussion • Research
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Product based assessment • Project based assessment

Learning outcome 4: Demonstrate electrostatic phenomena	Learning hours: 8

Indicative content

- **Description of electrostatic charges and their conservation**

✓ Electric charges
- Elementary charge
- Point charge
- Sign and magnitude of electric charges
- Laws of electrostatic charges
- Conservation of electric charges

✓ Electrification (charging) methods
- Electrification by rubbing
- Electrification by contact
- Electrification by induction

✓ Electrostatic field
- Electric field lines
- Electric field at a point charge
- Electric field between two charges

- **Determination of the electrostatic fields**

✓ Coulomb's law of electrostatic charges
- Electric permittivity
- Coulomb's law
- Mathematical treatment of coulombs of electrostatic charges

✓ Electric field intensity and potential
- Electric field intensity and its mathematical treatment
- Electric field strength due to distribution of electric field.
- Electric field potential and its mathematical treatment

✓ Effect of an electrostatic field on a moving charge
- Charge deflection
- Charge acceleration

- **Demonstration of effects of electric field on charged particles**

✓ Capacitors
- Definition of Capacitance
- Parallel-plate capacitor
- Effective capacitance for capacitor network

✓ Electrostatic energy stored by a capacitor
- Description of energy in capacitors

- Calculation of energy stored in capacitors

✓ Examples of electrostatic phenomena
- Electrostatic discharge
- Lightning arrestors
- Paint spraying
- Photocopier machines

Resources required for the indicative content	
Equipment	PPE, whiteboard and chalkboard, computer, projector, textbooks
Materials	Chalks, markers
Tools	Scientific calculator, meter ruler, compass
Facilitation techniques	• Demonstration and simulation • Individual and group work • Practical exercise • Trainer guided • Group discussion • Research
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Product based assessment • Project based assessment

Learning outcome 5: Apply Geometric optics	Learning hours: 7

Indicative content

- **Explanation of light**

✓ Key terms
- Definition of optics
- Definition of geometrical optics
- Properties of light

- **Application of light reflection on surfaces**

✓ Laws of reflection
- Definition of light reflection
- Types of reflection of light
- Ray diagram for reflection

- Laws of reflection
- Parallax method

✓ Formation of image in mirrors
- Plane mirror
- Spherical mirrors

✓ Applications of light reflection
- Reflecting periscope
- Car side mirrors

- **Application of light refraction in different media**

✓ Key terms
- Interface
- Refraction

✓ Laws of refraction
- 1st law of refraction
- Snell's law of refraction

✓ Real and apparent depth

✓ Total internal reflection
- critical angle

✓ Refraction of light
- Refraction of light in Prism
- Refraction of light in thin lenses

Resources required for the indicative content	
Equipment	PPE, whiteboard, chalkboard, optical bench, optical slide, computer, projector, textbooks
Materials	Chalks, markers, candles, water
Tools	Scientific calculator, meter ruler, prism, thin lenses, compass
Facilitation techniques	• Demonstration and simulation • Individual and group work • Practical exercise • Trainer guided • Group discussion • Research
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Product based assessment • Project based assessment

Learning outcome 6: Characterize sources of energy in the world	Learning hours: 6

Indicative content

- **Explanation of basic concepts of work, energy and power**

✓ Explanation of work
- Positive work
- Negative work
- Zero work
- Net or unbalanced work

✓ Explanation of energy
- Physical meaning of energy
- Mechanical energy
- Energy conservation law
- Work-energy theorem for linear motion

✓ Explanation of power
- Meaning of power
- Calculation of power
- Energy dissipation
- Efficiency of machines

- **Identification of types of energy**

✓ Energy
- Description of energy
- source of energy

✓ Identification of sources of energy
- Renewable sources of energy
- Non-renewable sources of energy

✓ Formation of energy
- Formation of renewable energy systems.
- Formation of non-renewable energy systems

- **Analyzing relative advantages and disadvantages of various energy sources**

✓ Non- renewable (fossil fuel) energy
- Oil
- Coal
- Natural gases

✓ Renewable sources
- Wind

➢ Solar ➢ Geothermal ➢ Hydropower	
Resources required for the indicative content	
Equipment	PPE, whiteboard and chalkboard, computer, projector, textbooks
Materials	Chalks, markers
Tools	Scientific calculator
Facilitation techniques	• Demonstration and simulation • Individual and group work • Practical exercise • Trainer guided • Group discussion • Research
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment

References:

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