Republic of Rwanda
Ministry of Education

RTB | RWANDA TVET BOARD

APPLIED PHYSICS

GENDM502

Apply Dynamics and Mechanical waves

Competence

RQF Level: 5

Learning Hours 40

Credits: 4

Sector: CONSTRUCTION & BUILDING SERVICES, ENERGY, TRANSPORT AND LOGISTICS, AGRICULTURE AND FOOD PROCESSING

Trade: Building Construction, Public Works, Plumbing Technology, Interior Design, Land Surveying, Electrical Technology, Renewable Energy, Heavy Machinery, Automobile Technology, Wood Technology, Water and Irrigation

Module Type: General

Issue Date: May 2023

CURRICULUM: GENDM502-TVET CERTIFICATE 5– CONSTRUCTION & BUILDING SERVICES, ENERGY, TRANSPORT AND LOGISTICS, AGRICULTURE AND FOOD PROCESSING

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<table>
<tr><td>Purpose statement</td><td colspan="5">This module describes knowledge, skills and attitudes required to apply concepts of dynamics and mechanical waves. At the end of this module, the leaner will be able to describe motion in orbits, climate change and greenhouse effect, apply oscillations and mechanical waves.</td></tr>
<tr><td rowspan="6">Delivery modality</td><td colspan="2">Training delivery</td><td>100%</td><td colspan="2">Assessment</td><td>Total 100%</td></tr>
<tr><td colspan="2">Theoretical content</td><td>30%</td><td rowspan="4">Formative assessment</td><td>30%</td><td rowspan="4">50%</td></tr>
<tr><td colspan="2">Practical work:</td><td rowspan="3">70%</td><td rowspan="3">70%</td></tr>
<tr><td>• Group project and presentation</td><td>20%</td></tr>
<tr><td>• Individual project /Work</td><td>50%</td></tr>
<tr><td colspan="3"></td><td colspan="2">Summative Assessment</td><td>50%</td></tr>
</table>

Elements of Competency and Performance Criteria

Elements of competency	Performance criteria	
1. **Describe motion in orbits**	1.1.	Universal gravitation motion in orbits is clearly described based on celestial objects
	1.2.	Kepler's laws are properly explained based on celestial objects
	1.3.	Rockets and satellites are clearly described based on planetary motion
2. **Apply Oscillations and mechanical waves**	2.1.	Oscillatory motion is clearly described referring on oscillating systems
	2.2.	Effects of oscillations on oscillating systems are clearly described based on their types
	2.3.	Oscillatory motion is properly explained based on mechanical waves
3. **Describe Climate change and Greenhouse effect**	3.1.	Intensity of the sun's radiation reaching planets is clearly described based on solar system
	3.2.	Greenhouse effect is clearly explained according to the type of greenhouse gases (GHG)
	3.3.	Climate change is properly explained based on its causes

Course content

Learning outcomes	At the end of the module the learner will be able to: 1. **Describe motion in orbits** 2. **Apply Oscillations and mechanical waves** 3. **Describe Climate change and Greenhouse effect**

Learning outcome 1: Describe motion in orbits	**Learning hours: 15**

Indicative content

- **Description of universal Gravitation motion in orbits**
  - ✓ Universal Gravitation
    - Definition of orbital motion and universal gravitation
    - State of Newton's law of universal Gravitation.
    - Measurement of Gravitational constant
    - Determination of Gravitational force of bodies moving in orbits
  - ✓ Free-fall acceleration and the Gravitational force
    - Variation of g with altitude,
    - The density of the earth
- **Explanation of Kepler's laws**
  - ✓ Kepler's laws
    - Kepler's first law
    - Kepler's second law
    - Kepler's third law
    - Application of Kepler 's laws.
  - ✓ The motion of celestial objects in orbits
    - Definition of Planetary motion
    - Movement of the planets, stars and other celestial objects
    - Kepler's conclusion about Brahe's data.
- **Description of Rockets and satellites motion**
  - ✓ **Planetary motion**
    - Gravitational field
    - Mathematical treatment of gravitational field
  - ✓ Motion of rocket, satellite and space crafts

- Classification of satellites orbits and space crafts
- Movement of satellites in orbits
- Escape speed of a rocket and satellite

✓ Description of three Cosmic velocities

- First cosmic velocity
- Second cosmic velocity
- Third cosmic velocity.

Resources required for the indicative content	
Equipment	PPE, whiteboard, 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 • Product based assessment • Project based assessment

Learning outcome 2: Apply oscillations and mechanical waves	**Learning hours: 15**

Indicative content

- **Description of oscillatory motion**

✓ Simple harmonic motion (S.H.M)

- Definition of oscillatory motion
- Mathematical representation of S.H.M
- Conditions necessary for an oscillating system to be S.H.M.
- Motion of an object attached to a spring
- Hooke's law
- Restoring force

- ✓ Energies of the simple harmonic oscillator
  - Kinetic energy (K.E.)
  - Potential energy (P.E.)
  - Mechanical energy (M.E.)
  - Representation of K.E., P. E and M. E. on a graph
- ✓ Simple pendulum

- **Description of effects of oscillations**
  - ✓ Damped oscillations
    - Example of a damped oscillator
    - Retarding force
    - Damping coefficient
    - Types of damping and their representation on a graph
  - ✓ Forced oscillations
    - Examples of forced oscillating systems
    - Resonance
    - Resonance and natural frequency
    - Effects of resonance on physical systems
- **Explanation of oscillatory motion**
  - ✓ Wave motion
    - Propagation of a disturbance
    - Propagation of wave
    - Types of waves
  - ✓ Mechanical waves as a source of oscillation
    - Source of mechanical waves
    - Propagation of mechanical waves
    - Some examples of mechanical waves
    - Effects of mechanical waves as a source of oscillation on systems.

Resources required for the indicative content	
Equipment	PPE, Whiteboard, chalkboard Computer, Projector, Textbooks
Materials	Chalks, Markers
Tools	Scientific calculator, Spring, Spherical balls, Stop watch
Facilitation techniques	• Demonstration and simulation • Individual and group work • Practical exercise • Trainer guided • Group discussion • Search engine

Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Product based assessment • Project based assessment

Learning outcome 3: **Describe Climate change and Greenhouse effect**	**Learning hours: 10**
Indicative content	

- **Description of intensity of the sun's radiation reaching planets**
  - ✓ Definition of black body radiation
  - ✓ Description of Intensity of the sun's radiation and Albedo
    - intensity of the sun's radiation
    - Albedo
    - Application of formula of Albedo
  - ✓ Identification of factors affecting planet's Albedo:
    - Clouds
    - Oceans
    - Surface Albedo.
- **Explanation of greenhouse effects**
  - ✓ Greenhouse gases
  - ✓ Explanation of Impact of greenhouse effect on climate change:
    - Greater strength of extreme weather events
    - Rising sea levels
    - Melting of glaciers and polar ice
    - Increasing acidity in the ocean
  - ✓ Explanation of Human activities causing global warming
    - Burning of fossil fuel
    - Deforestation
    - Agriculture
  - ✓ Explanation of Natural phenomena causing Global warming:
    - Volcanic eruption
    - Ocean currents
- **Explanation of climate change and mitigation measures**
  - ✓ Explanation of key terms
    - Climate change

- Climate lag
- Climate model
- Climate feedback

✓ Explanations of mitigations measures.

Resources required for the indicative content	
Equipment	PPE, Whiteboard and chalkboard Computer, Projector, Textbooks
Materials	Chalkboard, chalks, Markers
Tools	Scientific calculator
Facilitation techniques	• Demonstration and simulation • Individual and group work • Practical exercise • Trainer guided • Group discussion • Search engine • Scenarios of environmental journals
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Product based assessment • Project based assessment

References:

1. E school today. (2008-2018). Retrieved February 19, 2018, from natural disasters: http
2. Avison, J. (1989). The world of PHYSICS. Cheltenham: Thomas Nelson and Sons Ltd.
3. Chand, S., & S.N., G. S. (2003). Atomic Physics (Modern Physics) (1 ed.). India.
4. CPMD. (2015). Advanced Level Physics Syllabus. Kigali: REB.
5. Cunningham, & William, P. (2000). Environmental science (6 ed.). Mc Graw-Hill.
6. Cutnell, J. D., & Johnson, K. W. (2006). Essentials of Physics. USA: John Wlley &Sons, Inc.
7. Cutnell, J. D., & Johnson, K. W. (2007). Physics. (7 ed.). USA: John Wiley; Sons, Inc
8. Cuttnell, J. D., & kennety, W. J. (2007). Physics (7 ed.). United State of America: John Willey & Sons. Inc
9. Douglass, C. G. (2014). PHYSICS, Principles with applications. (7 ed.). Pearson Education
10. Douglass, C. G. (2014). PHYSICS, Principles with applications. (8 ed.). Pearson Education.
11. Duncan, T., & Kennett, H. (2000). Advanced Physics (5 ed.). London, UK: Holder Education.
12. Giancoli, D. (2005). PHYSICS: Principles with applications. New Jersey: Pearson Education, Inc.
13. Giancoli, D. C. (2005). Physics principals with application. Upper Saddle River, NJ 07458: Pearson Education, Inc.

14. Giancoli, D. C. (2005). Physics: principals with application. Upper Saddle River, NJ 07458: Pearson Education, Inc.
15. MIDIMAR. (2012). Disaster High Risk Zones on Floods and Landslide. Kigali: MIDMAR
16. Office, U. M. (2011). Warming: A guide to climate change. U.K.: Met Office Hadley Centre.
17. Randall, D., & Knight. (2004). Physics for scientists and engineers: Strategic approach (Vol. 2). San Francisco: Pearson Education.
18. Randall, D., & Knight. (2004). Physics for scientists and engineers: Strategic approach. (Vol. 3). San Fransisco: Pearson Education, Inc.
19. Randall, D., & Knight. (2008). Physics for scientists and engineers: Strategic approach. (2 ed., Vol. 3). San Francisco: Pearson Education, Inc.
20. REMA. (n.d.). Rwanda Second National Communication under the UNFCCC. KIGALI: MINISTRY OF NATURAL RESOURCES, RWANDA
21. Science, G. (2006). Florida Physical Science with Earth Science. USA: Mc Graw Hill Glencoe Companies, Inc.
22. Serway, R. A. (1986). Physics for Scientists and Engineers (2 ed.). Saunders College Publishing.
23. IPCC. (1996). Economics of Greenhouse Gas limitation, Main report "Methodological Guidelines.
24. John, M. (2009). Optical Fiber Communications, Principals and Practice (3rd Ed.). London: Pearsnon Prentice Hall.
25. Tipler, P. A. (1991). Physics for Scientists and Engineers. (3 ed., Vol. 1). USA: Worth Publishers, Inc