



Republic of Rwanda  
Ministry of Education



## Applied Mathematics

**GENFA402**

### Apply Fundamental Mathematical Analysis

RQF Level: 4

#### Competence

Learning Hours

60

Credits: 6



Sector: All sector except hospitality and tourism, arts and crafts

Trade: All trades except Fashion design, Fine and Plastic Art, Music and Performing Arts, Food and Beverages Operations, Front Office and Housekeeping operations, Tourism

Module Type: General

**Issue Date: May 2023**

**CURRICULUM: GENFA402-TVET CERTIFICATE 4 - ALL SECTORS EXCEPT HOSPITALITY AND TOURISM, ARTS AND CRAFTS**

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Purpose statement	This general module describes the knowledge, skills and attitudes required to apply fundamental mathematical analysis. At the end of this module, the learner will be able to analyze algebraic functions, fundamentals of differentiation, natural logarithmic and exponential functions.					
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
<b>1 Analyze algebraic functions</b>	1.1 The domain and range of algebraic function are accurately determined based on existence conditions.
	1.2 Symmetry (parity) of algebraic function is adequately identified based on definitions of key words (even and odd).
	1.3 Limits of a function are correctly determined based on theory of calculating limits.
	1.4 The asymptotes are accurately determined based on limits calculation.
<b>2 Apply fundamentals of differentiation</b>	2.1 Derivative is properly determined by using limit method.
	2.2 Derivative of a function is adequately interpreted by illustrating a curve with its tangent and secant line.
	2.3 Derivative is appropriately applied based on definitions and calculation
	2.4 Curve of an algebraic function is accurately sketched based on the table of variation
<b>3. Apply exponential functions</b>	3.1 The domain of definition of function is accurately determined based on existence condition.
	3.2 Exponential equations are correctly solved based on their properties
	3.3 Limit of exponential function is correctly calculated based on properties of exponential

<b>4. Apply logarithmic functions</b>	3.4 Exponential function is correctly differentiated based on definition of derivative
	3.5 The graph of exponential functions is appropriately sketched according to the table of variation
	4.1 The domain of logarithmic functions is properly determined based on existence conditions.
	4.2 Logarithmic equations are correctly solved based on their properties
	4.3 Limit of logarithmic function is properly calculated based on logarithmic properties.
	4.4 Logarithmic function is correctly differentiated according to definition of derivative.
	4.5 The graph of logarithmic function is appropriately sketched based on table of variation.

## Course content

<b>Learning outcomes</b>	<b>At the end of the module the learner will be able to:</b> <ol style="list-style-type: none"> <li>1. Analyze algebraic functions</li> <li>2. Apply fundamentals of differentiation</li> <li>3. Apply exponential functions</li> <li>4. Apply logarithmic functions</li> </ol>
<b>Learning outcome 1: Analyze algebraic functions</b>	<b>Learning hours: 15</b>
<b>Indicative content</b>	
<ul style="list-style-type: none"> <li>• <b>Determination of the domain and range of algebraic function</b> <ul style="list-style-type: none"> <li>✓ Existence condition</li> <li>✓ Domain of definition of a function</li> <li>✓ Range of a function</li> </ul> </li> <li>• <b>Identification of symmetry of algebraic function</b> <ul style="list-style-type: none"> <li>✓ Even function</li> <li>✓ Odd function</li> </ul> </li> <li>• <b>Determination of function limits</b> <ul style="list-style-type: none"> <li>✓ Finite limits</li> <li>✓ Infinite limits</li> <li>✓ Limit at infinity</li> <li>✓ Remove of indeterminate cases</li> </ul> </li> </ul>	

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- **Determination of asymptotes**

- ✓ Rational functions
- ✓ Irrational functions

### Resources required for the learning outcome

Equipment	Computer, projector
Materials	Reference Books ,Didactic materials such as manila paper
Tools	Hand-out notes, internet
Facilitation techniques	<ul style="list-style-type: none"> <li>• Demonstration and simulation</li> <li>• Practical exercise</li> <li>• Individualized</li> <li>• Trainer guided</li> <li>• Group discussion</li> <li>• Pairing work on boundaries of domain of definition</li> <li>• Documentary Research</li> </ul>
Formative assessment methods	<ul style="list-style-type: none"> <li>• Written assessment</li> </ul>

### Learning outcome 2: Apply fundamentals of differentiation

Learning hours: 20

#### Indicative content

- **Determination of derivatives**
  - ✓ Derivative of function at a given point
  - ✓ Derivative of a polynomial function
  - ✓ Derivative of a rational and irrational functions
  - ✓ Successive derivatives
- **Interpretation of derivative of a function**
  - ✓ Geometric interpretation
  - ✓ Kinematical meaning of a derivative
- **Application of derivative**
  - ✓ Determination of equation of tangent and normal lines at a given point
  - ✓ Increasing and decreasing intervals for a function
  - ✓ Maximum and minimum points of a function

- ✓ Concavity, inflection point on a graph

- **Sketching curve of algebraic function**

- ✓ **Establishing required parameters**



Variation table



Additional points

- ✓ Sketching graph of polynomial function
- ✓ Sketching graph of rational and irrational functions

### Resources required for the indicative content

Equipment	Computer, projector
Materials	Reference book, Didactic materials such as manila paper
Tools	Hand-out notes , Scientific calculator, Internet, Geometric instruments (Ruler, T-square)
Facilitation techniques	<ul style="list-style-type: none"> <li>• Individual and group work</li> <li>• Practical exercise</li> <li>• Trainer guided</li> <li>• Group discussion on different types of function</li> <li>• Practical exercises on sketching graph</li> <li>• Individual exercises on sketching graph</li> <li>• Documentary Research</li> </ul>
Formative assessment methods	<ul style="list-style-type: none"> <li>• Written assessment</li> </ul>

### Learning outcome 3: Apply exponential functions

Learning hours: 15

#### Indicative content

- **Determination of the domain of definition of functions**

- ✓ Existence condition
- ✓ Domain of definition of a function

- **Solving exponential equation**

- ✓ Domain of validity
- ✓ Solution set

- **Calculation of the limit of exponential functions**

- ✓ Finite limits
- ✓ Limits at infinity
- ✓ Deduction/ calculation of Asymptotes

- **Differentiation of exponential functions**

- ✓ Derivation
- ✓ Table of variation

<ul style="list-style-type: none"> <li>• <b>Sketching graph of exponential functions</b> <ul style="list-style-type: none"> <li>✓ Table of additional point</li> <li>✓ Graph</li> </ul> </li> </ul>	
<b>Resources required for the indicative content</b>	
Equipment	Computer, projector
Materials	Reference books, Didactic materials such as manila paper
Tools	Hand-out notes, internet, Geometric instruments (Ruler, T-square)
Facilitation techniques	<ul style="list-style-type: none"> <li>• Brainstorming on variation table</li> <li>• Individual and group work</li> <li>• Practical exercise</li> <li>• Trainer guided</li> <li>• Group discussion on sketching graph</li> <li>• Individual work on sketching graph</li> <li>• Documentary Research</li> </ul>
Formative assessment methods	<ul style="list-style-type: none"> <li>• Written assessment</li> </ul>

<b>Learning outcome 4: Apply logarithmic functions</b>	<b>Learning hours: 10</b>
<b>Indicative content</b>	
<ul style="list-style-type: none"> <li>• <b>Determination of the domain of definition</b> <ul style="list-style-type: none"> <li>✓ Existence condition</li> <li>✓ Domain of definition of a function</li> </ul> </li> <li>• <b>Solving logarithmic equation</b> <ul style="list-style-type: none"> <li>✓ Domain of validity</li> <li>✓ Solution set</li> </ul> </li> <li>• <b>Calculation of the limit of logarithmic functions</b> <ul style="list-style-type: none"> <li>✓ Finite limits</li> <li>✓ Limits at infinity</li> <li>✓ Deduction/ calculation of Asymptotes</li> </ul> </li> <li>• <b>Differentiation of logarithmic functions</b> <ul style="list-style-type: none"> <li>✓ Derivation</li> <li>✓ Table of variation</li> </ul> </li> <li>• <b>Sketching graph of logarithmic functions</b> <ul style="list-style-type: none"> <li>✓ Table of additional point</li> <li>✓ Graph</li> </ul> </li> </ul>	

## Resources required for the indicative content

Equipment	Computer, projector
Materials	Reference books, Didactic materials such as manila paper ,Geometric instruments (Ruler, T-square)
Tools	Hand-out notes, internet
Facilitation techniques	<ul style="list-style-type: none"> <li>Brainstorming variation table</li> <li>Demonstration and simulation</li> <li>Individual and group work</li> <li>Practical exercise</li> <li>Trainer guided</li> <li>Group discussion</li> <li>Pairing work on sketching graph</li> <li>Documentary Research</li> </ul>
Formative assessment methods	<ul style="list-style-type: none"> <li>Written assessment</li> </ul>

## References:

1. A. J. Sadler, D. W. S. Thorning (1987). *Understanding Pure Mathematics*, Oxford University Press.
2. Arthur Adam, Freddy Goossens and Francis Lousberg (1991). *Mathematisons 65*, DeBoeck, 3<sup>rd</sup> edition.
3. David Rayner (2000). *Higher GCSE Mathematics*, Oxford University Press.
4. DPES- RWANDA (1990). *Complexes 5<sup>th</sup>*, Livre de l'élève. IMPRISCO-Kigali.
5. Frank Ebos, Dennis Hamaguchi, Barbana Morrison & John Klassen (1990), *Mathematics Principles & Process*, Nelson Canada A Division of International Thomson Limited.
6. George B. Thomas, Maurice D. Weir & Joel R. Hass (2010), *Thomas' Calculus Twelfth Edition*, Pearson Education.
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9. Ngezahayo, E. P. (2017). *Advanced Mathematics for Rwanda Secondary Schools. Learners' Book Senior Five*. Kigali: Fountain.
10. Ngezahayo, E. P. (2016). *Advanced Mathematics for Rwanda Secondary Schools. Learners' Book Senior Four*. Kigali: Fountain.