

**REPUBLIC OF RWANDA**



**MINISTRY OF EDUCATION**



**SUBSIDIARY MATHEMATICS SYLLABUS FOR LFK, HLP& HGL**

Kigali, August 2022

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## **FOREWORD**

Rwanda Basic Education Board (REB) is honoured to avail the Subsidiary Mathematics Syllabus for Literature in English – French – Kinyarwanda-Kiswahili (LFK), History- Literature in English – Psychology (HLP), History- Geography- Literature in English (HGL) combinations. This document serves as official guide to teaching and learning of Subsidiary- Mathematics in LFK, HLP, and HGL combinations.

The Rwandan education philosophy is to ensure that young people at every level of education achieve their full potential in terms of relevant knowledge, skills and appropriate attitudes and values that prepare them to be well integrated in the society and exploit employment opportunities.

The Ministry of Education, through Rwanda Basic Education Board (REB), has undertaken the task to introduce Subsidiary Mathematics subject in the LFK, HLP, and HGL combinations. The underlying principle behind the introduction of this subject is to ensure that the curriculum responds to the needs of the Learners, the society, and the labour market. Mathematics is one of subjects of Competence Based Curriculum that contributes to shape the Learners with required knowledge, skills, attitudes, and values to produce well-trained Learners at Secondary school level. Sub-Mathematics subject teaches the mathematical operations, sequences, algebraic functions, equations and inequalities, Mathematical Logics, basic statistics and probability to train a Secondary school learner capable of successfully perform his/her duties.

The ambition to develop a knowledge-based society and the growth of regional and global competition in the jobs market has necessitated the shift to a competence-based syllabus. With the help of the teachers, whose role is central to the success of the syllabus, Learners will gain appropriate skills and be able to apply what they have learned in real life situations. Hence they will make a difference not only to their own lives but also to the success of the nation.

I wish to sincerely express my appreciation to the people who contributed towards the development of this Subsidiary Mathematics Syllabus, particularly, REB staff, Secondary school Mathematics Teachers for their technical support. A word of gratitude goes to the Head Teachers who availed their staff for the elaboration of Subsidiary Mathematics Syllabus.

Any comments or contributions towards the improvement of this syllabus for the next edition are welcome.

**Dr. MBARUSHIMANA Nelson**  
**Director General, REB.**

## **ACKNOWLEDGEMENT**

I wish to sincerely express my special appreciation to the people who played a role in the development of Subsidiary Mathematics syllabus for Literature in English – French – Kinyarwanda-Kiswahili (LFK), History- Literature in English – Psychology (HLP), History- Geography- Literature in English (HGL) combinations. The process would not have been successful without the support from different stakeholders.

I wish to sincerely express my appreciation to the people who contributed to the development of this syllabus until its completion. These are the secondary schools Head teachers who availed their staff at the development of this Subsidiary mathematics syllabus. Furthermore, I owe gratitude to Independent Mathematics expert for their guidance, expertise and technical support.

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## **1. GENERAL INTRODUCTION**

### **1.1. Background to curriculum review**

The Subsidiary Mathematics syllabus is developed to help learners in the LFK, HLP, and HLP combinations where Mathematics is not core subject.

The motive of developing the syllabus was to ensure that the syllabus is responsive to the needs of the learners and to enhance the competence-based learning. Emphasis in the development/elaboration is put more on skills and COMPETENCES and by benchmarking with syllabi elsewhere with best practices.

The subsidiary Mathematics syllabus guides the interaction between the teacher and the learners in the learning processes and highlights the COMPETENCES a learner should acquire during and at the end of each unit of learning.

Learners will have the opportunity to apply Mathematics in different contexts, and see its importance in daily life. Teachers help the learners appreciate the relevance and benefits for studying this subject in advanced level.

This syllabus is prepared to be taught in three periods a week in the following combinations:

Literature in English – French – Kinyarwanda-Kiswahili (LFK), History- Literature in English – Psychology (HLP), History- Geography- Literature in English (HGL).

### **1.2. Rationale of teaching and learning mathematics**

Mathematics subject in the LFK, HLP, and HLP combinations is designed to provide mathematical concepts with statistical aspects and logics in order to help Learners to demonstrate critical thinking, problem solving and decision making skills.

The syllabus concentrates on mathematical concepts that are useful tools for a learner to solve real life problems in knowledge based economy society. Particularly, statistical skills are needed for Learners to interpret and make decision on statistical data from different books, journals and relevant scientific/ research documents.

### **1.2.1. Mathematics and the society**

Mathematics plays an important role in society through abstraction and logic, counting, calculation, measurement, classifying, systematic study of shapes and motion. It is also used in natural and applied sciences. The applied Mathematics like statistics and probability play an important role in different games of chance, in the national census process, in scientific research, etc. In addition, some cross-cutting issues such as financial education (awareness), environment and sustainability, comprehensive sexuality education, standardization culture, peace and value education, inclusive education are incorporated into some of Mathematics units to improve social and economic welfare of Rwandan society.

Moreover, Mathematics is key to the Rwanda education ambition of developing a knowledge-based and technology-led economy since it provides to Learners all required knowledge and skills to be used in different learning areas. Therefore, Mathematics is an important subject as it supports other subjects. This subsidiary Mathematics–syllabus is intended to address gaps related to mathematical knowledge in the combinations where Mathematics as subject was not included.

### **1.2.2. Mathematics and Learners**

Learners in LFK, HLP, and HLP combinations need to acquire basic mathematical competences to be effective members of Rwandan society with the ability to carry out researches, estimate, analyze, interpret statistical data and read the commonly used scientific representations and graphs.

Therefore, Mathematics content equips Learners with knowledge, skills, attitudes and values necessary to enable them to succeed in an era of rapid technological growth and socio-economic development. Mastery of Mathematical ideas makes Learners being innovative and confident in problem solving. It enables the Learners to be systematic, creative and self-confident in using mathematical language and techniques to reason; think critically; develop imagination, initiative and flexibility of mind. In this regard, learning of Mathematics needs more practical problem-solving activities with opportunities for Learners to plan their own investigations and develop the scientific and mathematical competences and confidence.

As new technologies have had a dramatic impact on all aspects of life, wherever possible in Mathematics, Learners should gain experience of a range of ICT equipment and applications such as Geogebra, scientific calculators that can be used to make learning and teaching of Mathematics more enjoyable.

### **1.2.3 Competences**

Competence is defined as the ability to perform a particular task successfully, resulting from having gained an appropriate combination of knowledge, skills and attitudes.

The subsidiary Mathematics syllabus gives the opportunity to learners to develop different COMPETENCES, including the generic COMPETENCES.

Basic COMPETENCES are addressed in the stated broad subject competences and in objectives highlighted year on year basis and in each of units of learning. The generic COMPETENCES, basic competences that must be emphasized and reflected in the learning process are briefly described below and teachers will ensure that learners are exposed to tasks that help the learners acquire the skills.

### **Generic Competences and Values**

- **Critical and problem solving skills:** Learners use different techniques to solve mathematical problems related to real life situations. They are engaged in mathematical thinking; they construct, symbolize, apply and generalize mathematical ideas. The acquisition of such skills helps learners to think imaginatively and broadly to evaluate and find solutions to problems encountered in all situations.
- **Creativity and innovation:** The acquisition of such skills helps learners to take initiatives and use imagination beyond knowledge provided to generate new ideas and construct new concepts. Learners improve these skills through Mathematics contest, Mathematics competitions, etc.
- **Research:** This helps learners to find answers to questions basing on existing information and concepts and to explain phenomena basing on findings from information gathered.

- **Communication:** Learners communicate effectively their findings through explanations, construction of arguments and drawing relevant conclusions.

Teachers, irrespective of not being teachers of language, will ensure the proper use of the language of instruction by learners which will help them to communicate clearly and confidently and convey ideas effectively through speaking and writing and using the correct language structure and relevant vocabulary.

- **Cooperation, inter personal management and life skills:** Learners are engaged in cooperative learning groups to promote higher achievement than do competitive and individual work.

This will help them to cooperate with others as a team in whatever task assigned and to practice positive ethical moral values and respect for the rights, feelings and views of others. Perform practical activities related to environmental conservation and protection. Advocating for personal, family and community health, hygiene and nutrition and Responding creatively to the variety of challenges encountered in life.

- **Lifelong learning:** The acquisition of such skills will help learners to update knowledge and skills with minimum external support and to cope with evolution of knowledge advances for personal fulfillment in areas that need improvement and development

### **Broad Mathematics Competences**

During and at the end of learning process, the learner can:

- Recognize and describe the role played by mathematics and appreciate its social and economic implications in daily life;
- Apply statistical skills to elaborate Learners' school reports, interpret them and any other statistical data from different reference books, journals and relevant scientific documents.
- Use acquired skills to express logical statements and take appropriate decisions.

## **Mathematics and developing competences**

The national policy documents based on national aspirations identify some ‘basic competences’ alongside the ‘generic competences’ that will develop higher order thinking skills and help Learners learn subject content and promote application of acquired knowledge and skills.

Through observations, constructions, using symbols, applying and generalizing mathematical ideas, and presentation of information during the learning process, the learners will not only develop deductive and inductive skills but also acquire cooperation and communication, critical thinking and problem solving skills. This will be realized when learners make presentations leading to inferences and conclusions at the end of each learning unit. This will be achieved through learners’ group work and cooperative learning which in turn will promote interpersonal relations and teamwork.

The acquired knowledge in learning should develop a responsible citizen who adapts to scientific reasoning and attitudes and develops confidence in reasoning independently. The learner should show concern of individual attitudes, environmental protection and comply with the scientific method of reasoning. The scientific method should be applied with the necessary rigor, intellectual honesty to promote critical thinking while systematically pursuing the line of thought.

## **2. PEDAGOGICAL APPROACH**

The change to a competence-based curriculum is about transforming learning, ensuring that learning is deep, enjoyable and habit-forming.

### **2.1. Role of the learner**

In the competence-based syllabus, the learner is the principal actor of his/her education. He/she is not an empty bottle to fill. Taking into account the initial capacities and abilities of the learner, the syllabus suggests under each unit, some activities of the learner and they all reflect active participation in the learning process.

The teaching and learning processes will be tailored towards creating a learner's friendly environment basing on the capabilities, needs, experience and interests.

The following are some of the roles or the expectations from the learners:

- Learners construct the knowledge either individually or in groups in an active way. From the learning theory, they move in their understanding from concrete through pictorial to abstract. Therefore, the opportunities should be given to learners to manipulate concrete objects and to use models.
- Learners are encouraged to use hand-held calculator or other ICT tools. This stimulates Mathematics as it is really used, both on job and in scientific applications.
- Learners work on one competence at a time to form concrete units with specific learning objectives (knowledge, skills, attitude and values).
- Learners will be encouraged to do research and present their findings through group work activities.
- A learner is cooperative: learners work in heterogeneous groups to increase tolerance and understanding.
- Learners are responsible for their own participation and ensure the effectiveness of their work.

## 2.2. Role of the teacher

In the competence-based curriculum, the teacher is a facilitator, organizer, advisor, a conflict solver, etc.

The specific duties of the teacher in a competence-based approach are the following:

He/ She is:

- A facilitator, his/her role is to provide opportunities for learners to meet problems that interest and challenge them and that, with appropriate effort, they can solve. This requires an elaborated preparation to plan the activities, the place they will be carried and the required assistance;
- An organizer: his/her role is to organize the learners in the classroom or outside and engage them through participatory and interactive methods through the learning processes as individuals, in pairs or in groups. To ensure that the learning is personalized, active, participative and co-operative, the teacher must identify the needs of the learners, the nature of the learning to be done, and the means to shape learning experiences accordingly;
- An advisor: he/she provides counselling and guidance for learners in need. He/she comforts and encourages learners by valuing their contributions in the class activities;
- A conflict-solver: most of the activities are performed in groups. The members of a group may face misunderstanding problems related to the attribution of tasks; they should find useful and constructive interventions of the teacher as a unifying element.
- Ethical and preaches for examples by being impartial, a role-model, caring for individual needs, especially for slow learners and those with physical impairments, through a special assistance, by providing remedial activities or reinforcement activities.

### **2.3. Special Needs Education and Inclusive Education Approach**

All Rwandans have the right to access education regardless of their different needs. The underpinnings of this provision would naturally hold that all citizens benefit from the same menu of educational programs. The possibility of this assumption is the focus of special needs education. The critical issue is that we have learners who are totally different in their ways of living and learning as opposed to the majority. The difference can either be emotional, physical, sensory and intellectual learning challenged.

These learners equally have the right to benefit from the free and compulsory basic education in the nearby ordinary/mainstream colleges. Therefore, the college's role is to enroll them and also set strategies to provide relevant education to them. The teacher therefore is requested to consider each learner's needs during teaching and learning process. Assessment strategies and conditions should also be standardized to the needs of these learners. Detailed guidance for each category of learners with special education needs is provided for in the guidance for teachers. The teacher is advised to work closely with the teacher of special need education to provide appropriate support to any identified learner's needs.

### **2.4. SKILLS LAB PEDAGOGY IN MATHEMATICS**

Mathematics is a practical subject in which learners can learn and explore various mathematical concepts , verify different mathematical facts and theories using a variety of practical activities and material. The use of Skill Lab helps to integrate theory and practical work in mathematics teaching and learning where Learners develop competences and apply acquired skills. Skills lab ensures teachers are accountable to completing all the learning activities and projects as outlined in the syllabus.

The basic characteristics of Skills Lab are:

- Learners work in small groups (manageable teams)
- Assessment takes place through portfolio activities
- Learners talk more than teachers (10% teacher talk time and the rest is for the Learners)
- Learners receive constructive feedback on their work (Teacher gives quality feedback on learner presentations).
- Skills lab consists of three components: build, practice and present.



Skills Lab in Mathematics makes a moment in which the learner is active, discusses and argues her/his own choices, builds meanings, learns to collect data and to compare them with the models. It is important for valorising the experience and knowledge of the Learners, the discovery and the collaborative learning. This learning must also be done through practice, discussion, exploration, development of thinking about the practice and way for building knowledge.

Practical activities to be done will help to reduce the abstract nature of the Mathematics subject and draw the Learners to participate in the classroom where the vague theories and imaginary objects of mathematics take real shape which facilitates Learners to understand and perform better.

Role of the teacher is to prepare practical activities, to set groups of learners and assign them their roles and responsibilities. The teacher has to explore Learners' works, to analyse how and why the same final answer or product can be the result of different process or constructions followed by Learners, to mark and provide feedback and remediation to Learners.

The teacher has also to guess strategies used by Learners when doing a given activity. This is the analysis of possible solutions for a problem given to Learners considering that Learners can present only the starting and the final steps. The teacher has to guess the difficulties and misconception that Learners may face when they apply such a procedure in such a situation.

Role of the learner is to read carefully instructions related to the activity, apply the mathematics process in doing practical activity as provided. This process includes: reasoning, communication and connection, application and modelling, production of mathematics teaching and learning materials, apply thinking skills and heuristics.

Mathematical reasoning: Analyse mathematical situations and construct logical arguments. It is the habit of mind to be developed through application of mathematics in different contexts.

Communication: use mathematics language to express mathematical ideas and arguments precisely, concisely and logically.

Connections: see and make linkages among mathematical ideas, between mathematics and other subjects, and between mathematics and the real world.

Applications and modelling: connect mathematics that have been learnt to the real life situations, enhance understanding of key mathematical concepts and methods, as well as developing competences. Learners will have opportunity to apply problem solving and reasoning skills to tackle a variety of problems: open-ended and real world problems. They will use mathematical models to represent and solve problems.

Thinking skills: skills used in thinking process: classifying, comparing, analysing parts and whole, identifying patterns and relationships, induction, deduction, generalizing, and spatial visualization.

Heuristics: rules of thumb of what Learners can do to tackle a problem when the solution to the problem is not obvious such as using representation (drawing diagrams, tabulating), making a guess (trial and error, guess and check, making a supposition), walking through the process (acting it out, working backwards), and changing the problem (simplifying the problem or considering special cases).

Production of teaching and learning materials: Mathematics learners can be given practical activities of organizing or producing teaching materials by the use of local material available in their environment.

Therefore, when doing practical activities, Learners build the knowledge and understanding, practice acquired skills and present the findings from their researches.

The following are tasks for the Learners: group building, basic communication, get to know the community and learners, exploration and needs assessment, coaching and guidance on managing challenging situations, investigation, asking, finding problems and to work collaboratively with peers for solving them, self-development on observation and inquiry, using scientific method and scientific research, develop a sense of taking responsibility for one's own learning, represent and build models of relationships among objects

and events, communicate and discuss, argue correctly, understand views and arguments of the others, perceive and explore fascinating relationships and structures found in nature and in the creations of the human being.

In this regard, skills lab activities are the time when Learners combine the competences acquired to make learning more practical. Thus, in every unit, this syllabus suggests practical and learning activities that the teacher may adapt and give to Learners to ensure practical application of the competences acquired.

### **3. ASSESSMENT APPROACH**

Assessment is the process of evaluating the teaching and learning processes through collecting and interpreting evidence of individual learner's progress in learning and to make a judgment about a learner's achievements measured against defined standards. Assessment is an integral part of the teaching learning processes. In the new competence-based curriculum assessment must also be competence-based; whereby a learner is given a complex situation related to his/her everyday life and asked to try to overcome the situation by applying what he/she learned.

#### **3.1. Types of assessments**

There are two major types of assessment namely formative and summative assessments. Any form of assessment should reflect the three domains of learning, which are Cognitive, Psychomotor and Affective.

- Knowledge and understanding: Does the learners demonstrate an understanding of the Mathematics concepts? Has the learner mastered the Mathematics concepts/ facts?

**Indicators:** correctness of answers, coherence of ideas, logical reasoning, use correctly mathematical symbols and concepts, etc.

- Practical skills: How does the learner perform on aptitude and practical tests?

**Indicators:** accuracy, using appropriate methods, quality product, speed and efficiency, coherence.

- Attitude and values: How does the learner respond to a task or a situation?

What is the learner's behaviour? How the learner persists on solving a given problem?

### **3.1.1. Formative assessment**

Formative assessment helps to check the efficiency of the process of learning. It is done within the teaching/learning process.

Continuous assessment involves formal and informal methods used by schools to check whether learning is taking place. When a teacher is planning his/her lesson, he/she should establish criteria for performance and behavior changes at the beginning of a lesson. Then, at the end of every unit, the teacher should ensure that the key unit competences are achieved by all the learners basing on the criteria stated, before going to the next unit. The teacher will assess how well each learner masters both the subject and the generic competences described in the syllabus as well as the professional practices. From this, the teacher will gain a picture of the all-round progress of the learner. The teacher will use one or a combination of the following techniques: observation, pen and paper, and oral questioning.

### **3.1.2. Summative assessments**

When assessment is used to record a judgment of a competence development or performance of the learner, it serves a summative purpose. Summative assessment gives a picture of a learner's competence or progress at any specific moment. The main purpose of summative assessment is to evaluate whether competences have been achieved, to use the results for ranking or grading of learners, to

decide on progression and to promote learners to the next level of education and for certification. This assessment should have an integrative aspect whereby a learner must be able to show mastery of all competences. It can be internal School-based assessment or external assessment in the form of national examinations. School-based summative assessment should take place once at the end of each term and once at the end of the year. School summative assessment average scores for the subjects which are examined at the national level will be weighted and included in the final national examinations grade. For the subjects that are not examined externally, the grade should be part of the continuous assessment reflected in the learner's school reports.

### **3.2. Record keeping**

This is gathering facts and evidence from assessment instruments and using them to judge the learner's performance by assigning an indicator against the set criteria or standard. Whatever assessment procedures used generate data in the form of scores which will be carefully recorded and stored in a portfolio. The latter is used to decide remedial actions, alternative instructional strategy and as well as feed back to the learner. The records also are important to parents to check the learning progress and to advice accordingly. Finally, the records are very essential to the final assessment of the learner.

This portfolio is a folder (or binder or even a digital collection) containing the learner's work as well as the learner's evaluation of the strengths and weaknesses of the work. Portfolios reflect not only work produced (such as papers and assignments), but also it is a record of the activities undertaken over time as part of learner learning. Besides, it will serve as a verification tool for each learner that he/she attended the whole learning before he/she undergoes the summative assessment for the subject.

### **3.3. Item writing in summative assessment**

Before developing a question paper, a plan or specification of what is to be tested or examined must be elaborated to show the units or topics to be tested on, the number of questions in each level of revised Bloom's taxonomy and the marks allocation for each question.

In a competence-based curriculum, questions from higher levels of Bloom's taxonomy should be given more weight than those from knowledge and comprehension level.

Before developing a question paper, the item writer must ensure that the test or examination questions are tailored towards competence based assessment by doing the following:

- Identify topic areas to be tested on from the subject syllabus.
- Outline subject-matter content to be considered as the basis for the test.
- Identify learning outcomes to be measured by the test.
- Prepare a table of specifications.
- Ensure that the verbs used in the formulation of questions do not require memorization or recall answers only but also testing broad, subject and generic competences as stated in the syllabus.

## **4. RESOURCES**

### **4.1. Materials needed for implementation**

The following list shows the main materials/equipment needed in the learning and teaching process:

- Materials to encourage group work activities and presentations: Computers (Desktops & laptops) and projectors; Manila papers and markers, textbooks and handouts;
- Materials for drawing & measuring geometrical figures/shapes and graphs: Geometric instruments, ICT tools such as Geogebra or Microsoft Student ENCARTA.
- Materials for enhancing research skills: Textbooks and internet (the list of the textbooks to consult is given in the reference at the end of the syllabus and those books can be found in printed or digital copies).

- Materials to encourage the development of Mathematical models: scientific calculators, Geogebra Software, Math type, Matlab, wall chart, different math mobile applications etc.
- Locally made materials for counting, sorting, arranging, etc.

The technology used in teaching and learning of Mathematics has to be regarded as tools to enhance the teaching and learning process and not to replace teachers.

#### **4.2. Human resource**

The effective implementation of this curriculum needs a joint collaboration of educators at all levels. Given the required material, teachers are expected to accomplish their noble role as stated above. The staff in charge of education at District and sector level should ensure overall support to schools for a successful implementation. On the other hand, Head teachers and deputy head teacher in charge of studies are required to make a close follow-up and assess the teaching and learning of this subject due to their profiles in the schools. These combined efforts will ensure bright future careers and lives for learners as well as the contemporary development of the country.

In a special way, the teacher of Mathematics should have a firm of Technological, Pedagogical and Content Knowledge of teaching at secondary level. He/she should be qualified in Mathematics and have a firm ethical conduct. The teacher should possess the qualities of a good facilitator, organizer, problem solver, listener and adviser. He/she is required to have basic skills and competences of guidance and counseling because Learners may come to him or her for advice.

## 5. SYLLABUS UNITS

### 5.1 Presentation of the structure of the Syllabus Units

Subsidiary Mathematics is developed to be taught and learnt in advanced level of secondary education, where Mathematics is not core subject i.e. in S4, S5 and S6 respectively for LFK, HLP, and HLP combinations. At every grade, the syllabus is structured in Topic Areas, sub-topic Areas where applicable and then further broken down into Units to promote the uniformity, effectiveness and efficiency of teaching and learning Mathematics. The units have the following elements:

1. Unit is aligned with the Number of Lessons.
2. Each Unit has a Key Unit Competence whose achievement is pursued by all teaching and learning activities undertaken by both the teacher and the learners.
3. Each Unit Key Competence is broken into three types of Learning Objectives as follows:
  - A. *Type I*: Learning Objectives relating to Knowledge and Understanding (*Type I* Learning Objectives are also known as Lower Order Thinking Skills or LOTS)
  - B. *Type II and Type III*: These Learning Objectives relate to acquisition of skills, Attitudes and Values (*Type II and Type III* Learning Objectives are also known as Higher Order Thinking Skills or HOTS) – These Learning Objectives are actually considered to be the ones targeted by the present reviewed curriculum.
4. Each Unit has a Content which indicates the scope of coverage of what to be taught and learnt in line with stated learning objectives
5. Each Unit suggests a non-exhaustive list of Learning Activities that are expected to engage learners in an interactive learning process as much as possible (learner-centered and participatory approach).
6. Finally, each Unit is linked to Other Subjects, its Assessment Criteria and the Materials (or Resources) that are expected to be used in teaching and learning process.



This Subsidiary Mathematics syllabus for LFK, HLP, and HLP has the following Topics:

- Arithmetic; Equations and inequalities; Descriptive statistics in senior 4
- Introduction to Logic; Point, lines and geometric shapes in 2D; Graphs and functions; Sequences in senior 5
- Bi-variate statistics; Counting techniques; Elementary probability in senior 6

## **5.2 Subsidiary Mathematics units for Senior Four**

### **5.2.1 Key Competences at the end of Senior Four**

After completion of Senior four subsidiary- Mathematics Topics, learners from LFK, HLP & HGL combinations will be able to:

- Apply preliminarily mathematical concepts in solving real life problems
- Use equations and inequalities to solve problems related to daily life
- Analyze and interpret statistical data from daily life situations (different reference books, journals and relevant scientific documents, etc) and draw appropriate conclusions.

### 5.2.2 Syllabus units for Senior Four

<b>Subject: Subsidiary Mathematics</b>		<b>Senior Four</b>	<b>Combinations: LFK, HLP&amp; HGL</b>	
<b>Topic Area: ALGEBRA</b>			<b>Sub Topic: NUMBERS AND OPERATIONS</b>	
<b>Unit 1: ARITHMETICS</b>			<b>Number of periods: 36</b>	
<b>Key Unit competence:</b> Apply preliminarily mathematical concepts in solving real life problems				
<b>Learning objectives</b>			<b>Content</b>	<b>Learning Activities</b>
<b>Knowledge and understanding</b>	<b>Skills</b>	<b>Attitudes and values</b>		
<ul style="list-style-type: none"> <li>❖ Define a fraction, decimal number, power, an exponential, a radical, decimal logarithm of a number and the absolute value of a real number.</li> <li>❖ Determine a simple and compound interest in a given mathematical problem.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Convert a fraction to a percentage and vice-versa;</li> <li>❖ Determine the percentage that corresponds to a given decimal number;</li> <li>❖ Illustrate properties of powers, a radicals, decimal logarithm, and absolute value of a real number.</li> <li>❖ Transform a logarithmic expression to equivalent power or radical form and vice versa</li> <li>❖ Use logarithm to model simple problems about compound interest, magnitude of an earthquake...</li> </ul>	<ul style="list-style-type: none"> <li>❖ Appreciate the importance and the use of properties of operations on real numbers;</li> <li>❖ Show curiosity for the study of operations on real numbers.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Basic arithmetic operations:                             <ul style="list-style-type: none"> <li>• Fractions</li> <li>• Decimals</li> <li>• Percentages</li> <li>• Ratios</li> <li>• Negative numbers</li> <li>• Absolute value</li> <li>• Powers</li> <li>• Radicals</li> <li>• Decimal logarithms</li> </ul> </li> <li>❖ Applications                             <ul style="list-style-type: none"> <li>• Simple and compound interest</li> <li>• Final value of investment</li> <li>• Arc of elasticity of demand.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>❖ Make research in the library about Sets of numbers (natural numbers, integers, rational numbers and irrational numbers).</li> <li>❖ Solve the provided variety of word problems that involve operations of real numbers: hire-purchase, simple interest and compound interest, etc</li> <li>❖ Use a bank loan related problem to calculate the compound interest.</li> </ul>
<b>Links to other subjects:</b> <i>Entrepreneurship and Economics</i>				
<b>Assessment criteria:</b> <i>Think critically to understand and perform operations on the set of real numbers</i>				
<b>Materials:</b> <i>Graph papers, manila papers, digital technology including calculators,...</i>				

<b>Subject: Subsidiary Mathematics</b>		<b>Senior Four</b>		<b>Combinations: LFK, HLP&amp; HGL</b>	
<b>Topic Area: ALGEBRA</b>				<b>Sub Topic: NUMBERS AND OPERATIONS</b>	
<b>Unit 2: Equations and inequalities</b>				<b>Number of periods: 36</b>	
<b>Key Unit competence:</b> Use equations and inequalities to solve problems related to daily life					
<b>Learning objectives</b>			<b>Content</b>	<b>Learning Activities</b>	
<b>Knowledge and understanding</b>	<b>Skills</b>	<b>Attitudes and values</b>			
<ul style="list-style-type: none"> <li>❖ List and clarify the steps in modeling a problem by linear equations and inequalities.</li> <li>❖ Give a formula for solving a quadratic equation.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Solve graphically and algebraically linear equations and inequalities</li> <li>❖ Relate mathematical solutions to simultaneous linear equations to economic analysis.</li> <li>❖ Factorize and solve quadratic equation;</li> <li>❖ Set up and solve real life problems that involve quadratic equations.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Appreciate the importance of linear equations and inequalities in a given situation;</li> <li>❖ Show concern in solving real life problems involving linear equations and inequalities.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Linear equations in one unknown and inequalities in one unknown <ul style="list-style-type: none"> <li>• Meaning of inequalities</li> <li>• Intervals</li> <li>• Inequalities of products/quotients</li> <li>• Real life problems involving linear inequalities</li> </ul> </li> <li>❖ Solving (graphically/geometrically) two Simultaneous linear equations with two variables</li> <li>❖ Solving quadratic equations (factorization or use of discriminant)</li> <li>❖ Applications of linear equations in daily life: Problems about supply and demand, finance, etc</li> </ul>	<ul style="list-style-type: none"> <li>❖ In groups, learners discuss on the importance and necessity of linear equations and inequalities and how it takes place in the buying and selling.</li> <li>❖ In pairs, learners solve linear equations and simultaneous equations.</li> <li>❖ Learners brainstorm the use of quadratic equations in their real life experiences.</li> </ul>	
<b>Links to other subjects:</b> Economics...					
<b>Assessment criteria:</b> Model and solve algebraically or graphically daily life problems using linear, quadratic equations or inequalities.					
<b>Materials:</b> Geometric instruments (ruler, T-square, ....), Digital technology including calculator,...					

<b>Subject: Subsidiary Mathematics</b>		<b>Senior Four</b>		<b>Combinations: LFK, HLP&amp; HGL</b>	
<b>Topic Area: STATISTICS</b>				<b>Sub Topic: DESCRIPTIVE STATISTICS</b>	
<b>Unit 3: Descriptive statistics</b>					<b>Number of periods: 36</b>
<b>Key Unit competence:</b> Analyze and interpret statistical data from daily life situations					
<b>Learning objectives</b>			<b>Content</b>	<b>Learning Activities</b>	
<b>Knowledge and understanding</b>	<b>Skills</b>	<b>Attitudes and values</b>			
<ul style="list-style-type: none"> <li>❖ Read and interpret a diagram of statistical data.</li> <li>❖ Identify mode, mean, median and range of statistical data</li> <li>❖ Define mean, mode, median, the quartiles, variance, standard deviation and the coefficient of variation.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Represent statistical information using: histogram, polygon, frequency distribution table and pie chart.</li> <li>❖ Interpret statistical data by the use of measures of centre tendency and measures of dispersion.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Appreciate how data collection, data representation and data interpretation can be used for solving real life situations.</li> <li>❖ Appreciate the importance of measures of dispersion in the interpretation of data</li> <li>❖ Show concern on how to use the standard deviation as measure of variability of data.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Definition and types of data</li> <li>❖ Data presentation <ul style="list-style-type: none"> <li>• Frequency distribution table</li> <li>• Bar chart</li> <li>• Pie chart</li> <li>• Histogram and Polygon</li> </ul> </li> <li>❖ Graph interpretation</li> <li>❖ Measures of central tendency (for ungrouped data and grouped data): mode, mean, median</li> <li>❖ Measures of dispersion: Range, Quartiles, Variance, Standard deviation, Coefficient of variation</li> <li>❖ Application: Collection,</li> </ul>	<ul style="list-style-type: none"> <li>❖ In group, learners will be given a data and be asked to:</li> <li>❖ Determine the measures of dispersion interpret them and represent their findings.</li> <li>❖ Represent data on graph papers, interpret them and infer conclusion.</li> <li>❖ Make a research on given problems arising from various situations in daily life, collect data, organize and investigate them statistically and represent the findings.</li> </ul>	

			organization, presentation and interpretation of data and draw conclusions.	
<b>Links to other subjects:</b> <i>Geography, Finance, Economics</i>				
<b>Assessment criteria:</b> <i>Extend understanding, analysis and interpretation of data arising from problems and questions in daily life to include the standard deviation.</i>				
<b>Materials:</b> <i>Manila papers, Graph Papers, ruler, digital technology including calculators ...</i>				

### **5.3 Subsidiary Mathematics units for Senior Five**

#### **5.3.1 Key competences for end of Senior Five**

After completion of Senior five subsidiary- Mathematics Topics, learners from LFK, HLP & HGL combinations will be able to:

- Use logical statements to clearly express or convey information and make appropriate decisions.
- Represent geometric shapes in 2D and calculate their area
- Apply graphical representation of functions to model problems related to daily life
- Use arithmetic and geometric sequences to solve problems related to daily life situations.

### 5.2.2 Syllabus units for Senior Five

<b>Subject: Subsidiary Mathematics</b>		<b>Senior Five</b>	<b>Combinations : LFK, HLP&amp; HGL</b>	
<b>Topic Area: ALGEBRA</b>			<b>Sub Topic: Mathematical logic and applications</b>	
<b>Unit 1: Introduction to Logic</b>			<b>Number of periods: 36</b>	
<b>Key Unit competence:</b> Use mathematical logic as a tool of reasoning and decision making in daily life				
<b>Learning objectives</b>			<b>Content</b>	<b>Learning Activities</b>
<b>Knowledge and understanding</b>	<b>Skills</b>	<b>Attitudes and values</b>		
<ul style="list-style-type: none"> <li>❖ Convert into logical formula compound statement and vice versa</li> <li>❖ Draw the truth table of a compound statement;</li> <li>❖ Define the most often used logical connectives and quantifiers;</li> <li>❖ Give an example of hypothetical syllogism.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Use mathematical logic to infer conclusion from given statement</li> <li>❖ Evaluate claims, issues and arguments, and identify mistakes in reasoning and prove the validity or invalidity of arguments in ordinary discourse.</li> <li>❖ Evaluate that a given logic statement is tautology or a contradiction.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Show concern on the use of correct statements and well formulated decisions;</li> <li>❖ Observe situations and make appropriate decisions</li> <li>❖ Appreciate and act with thoughtfulness: grasp and demonstrate carefulness...</li> </ul>	<ul style="list-style-type: none"> <li>❖ Introduction and fundamental definitions                             <ul style="list-style-type: none"> <li>• Logical statement</li> <li>• Simple Statement</li> <li>• Compound statement</li> </ul> </li> <li>❖ Truth values and Truth tables</li> <li>❖ Logical connectives and truth table                             <ul style="list-style-type: none"> <li>• The Negation “<b>not</b>”</li> <li>• The Conjunction “<b>and</b>”</li> <li>• The Disjunction “<b>or</b>”</li> <li>• Conditional (Concept , converse and contrapositive, inverse)</li> <li>• Bi-conditional or Equivalence “<b>if and only if</b>”</li> </ul> </li> <li>❖ Tautologies and Contradictions</li> <li>❖ Quantifiers and their negations                             <ul style="list-style-type: none"> <li>• The universal quantifier “<b>for all</b>”</li> <li>• Existence “<b>there exists</b>”</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>❖ Practical: Deduce if a given sentence is or is not a statement;</li> <li>❖ Group investigation: Make a research in advance in the library about syllogism and fallacy.</li> </ul>

			<ul style="list-style-type: none"> <li>• Negation of quantifiers</li> </ul>	
			<ul style="list-style-type: none"> <li>❖ Applications <ul style="list-style-type: none"> <li>• Hypothetical syllogism</li> <li>• Affirming antecedent</li> <li>• Denying consequence</li> </ul> </li> </ul>	
<b>Assessment criteria:</b> Use mathematical logic to organize scientific knowledge and as a tool of reasoning and argumentation in daily life				
<b>Links to other subjects:</b> All languages				
<b>Resources:</b> Manila paper, markers				

<b>Subject: Subsidiary Mathematics</b>		<b>Senior Five</b>		<b>Combinations : LFK, HLP&amp; HGL</b>	
<b>Topic Area: Geometry</b>				<b>Sub Topic: Plane geometry</b>	
<b>Unit 2: Point, lines and geometric shapes in 2D</b>				<b>Number of periods: 24</b>	
<b>Key Unit competence:</b> Represent geometric shapes in 2D and calculate their area					
<b>❖ Learning objectives</b>			<b>Content</b>	<b>Learning Activities</b>	
<b>Knowledge and understanding</b>	<b>Skills</b>	<b>Attitudes and values</b>			
<ul style="list-style-type: none"> <li>❖ Define the coordinate of a point in 2D.</li> <li>❖ Define a straight line.</li> <li>❖ List the geometric shapes in 2D</li> </ul>	<ul style="list-style-type: none"> <li>❖ Represent a point and a vector in 2D.</li> <li>❖ Calculate the distance between two points in 2D and the mid - point of a segment in 2D.</li> <li>❖ Determine the equations of a straight line (parametric equation, Cartesian equation).</li> <li>❖ Perform operations to determine the</li> </ul>	<ul style="list-style-type: none"> <li>❖ Appreciate that a point is a fixed position in a plane.</li> <li>❖ Be accurate in representations and calculations.</li> <li>❖ Manifest a satisfaction that geometric shapes are made by the intersection of lines in 2D.</li> <li>❖</li> </ul>	<ul style="list-style-type: none"> <li>❖ Points in 2D: <ul style="list-style-type: none"> <li>• Cartesian coordinates of a point</li> <li>• Distance between two points,</li> <li>• Mid-points of a line segment.</li> </ul> </li> <li>❖ Vectors in 2D (Concept and scalar/dot product with its properties)</li> <li>❖ Lines in 2D:</li> </ul>	<ul style="list-style-type: none"> <li>❖ Group discussion: on the distance between two points.</li> <li>❖ Making a representation of plane points and straight lines in a Cartesian.</li> <li>❖ Making a representation on graph paper of some chosen points lines and determine their parametric or</li> </ul>	



	<p>intersection of lines.</p> <ul style="list-style-type: none"> <li>❖ Calculate the area of geometric shapes in 2D.</li> </ul>		<ul style="list-style-type: none"> <li>• Vector equation</li> <li>• Parametric equations</li> <li>• Cartesian equation given: <ul style="list-style-type: none"> <li>- One point and direction vector.</li> <li>- 2 points.</li> <li>- One point and gradient</li> </ul> </li> <li>❖ Problems on points and straight lines in 2D: <ul style="list-style-type: none"> <li>• Positions (a point to the line, Two lines, Parallelism condition)</li> <li>• Angles,</li> </ul> </li> <li>❖ Perimeter and area of Geometric shapes in 2D (Square, Rectangle, triangle, parallelogram, pentagon and hexagon )</li> </ul>	<p>Cartesian equations.</p> <ul style="list-style-type: none"> <li>❖ Exercising the calculation of the area of geometric shapes in 2D.</li> </ul>
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**Assessment criteria:** Represent lines and calculate the area in 2D.

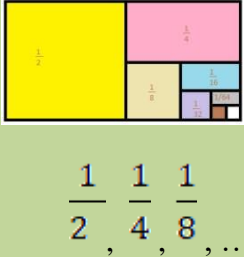
**Links to other subjects:** Social studies; Mathematics (primary level); construction.

**Resources:** Manila paper, graph paper, geometric instruments, ruler, model of geometric shapes in 2D, digital technology including calculators, computer, projector and internet.

<b>Subject: Subsidiary Mathematics</b>		<b>Senior Five</b>		<b>Combinations : LFK, HLP&amp; HGL</b>	
<b>Topic Area: ANALYSIS</b>				<b>Sub Topic: FUNCTIONS</b>	
<b>Unit 3: Functions and graphs</b>				<b>Number of periods: 24</b>	
<b>Key Unit competence:</b> Apply graphical representation of functions in solving economics and financial models					
<b>Learning objectives</b>			<b>Content</b>	<b>Learning Activities</b>	
<b>Knowledge and understanding</b>	<b>Skills</b>	<b>Attitudes and values</b>			
<ul style="list-style-type: none"> <li>❖ Identify a function as a rule and recognize rules that are not functions.</li> <li>❖ Determine the domain and range of a function.</li> <li>❖ Find the even and odd parts of a function.</li> <li>❖ Perform operations on functions.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Draw graphs that corresponds to linear, non-linear functions;</li> <li>❖ Find the slopes of linear functions and tangents to non-linear function by graphical analysis.</li> <li>❖ Use the slope of a linear demand function to calculate point elasticity</li> <li>❖ Analyze, model and solve problems involving linear or quadratic functions and interpret the results.</li> <li>❖ Interpret the meaning of functions with two</li> </ul>	<ul style="list-style-type: none"> <li>❖ Increase self-confidence and determination to appreciate and explain the importance of functions and how they are related or how are helpful to different event occurring in different domains.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Generalities on numerical functions: <ul style="list-style-type: none"> <li>• Definitions</li> <li>• Domain and range</li> <li>• Parity of a function (odd or even)</li> <li>• Operations on functions</li> </ul> </li> <li>❖ Graphical representation and interpretation of linear and quadratic functions</li> <li>❖ Applications of functions in Economics and finance: <ul style="list-style-type: none"> <li>• A linear demand functions and point of elasticity.</li> <li>• Marginal revenue/profit, marginal cost functions</li> <li>• Equilibrium price and quantity</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>❖ Study algebraically and graphically different simple functions.</li> <li>❖ Model or interpret the problems related to functions</li> </ul>	

	independent variables: marginal revenue and marginal cost functions.			
<b>Links to other subjects:</b> Economics ( Use of polynomials to represent the cost of producing “x” units of a commodity, or marginal cost,)				
<b>Assessment criteria:</b> Use concepts and definitions of functions to determine the domain of Polynomial, Rational and Irrational functions and represent them graphically in simple cases...				
<b>Materials:</b> Graph Papers, ruler, Digital technology (including calculators,...)				

<b>Subject: Subsidiary Mathematics</b>		<b>Senior Five</b>		<b>Option: LFK, HLP&amp; HGL</b>	
<b>Topic Area: ALGEBRA</b>				<b>Sub Topic: : NUMBER PATTERNS</b>	
<b>Unit 4: SEQUENCES</b>				<b>Number of periods: 24</b>	
<b>Key Unit competence:</b> Apply arithmetic and geometric sequences to solve problems related to daily life situations.					
<b>Learning objectives</b>			<b>Content</b>	<b>Learning Activities</b>	
<b>Knowledge and understanding</b>	<b>Skills</b>	<b>Attitudes and values</b>			
<ul style="list-style-type: none"> <li>❖ Define a sequence and understand arithmetic progressions and their properties.</li> <li>❖ Determine the value of “n”, given the sum of the first “n” terms of arithmetic progressions.</li> <li>❖ Show how to apply formulas to determine the “nth” term and the</li> </ul>	<ul style="list-style-type: none"> <li>❖ Use basic concepts and formulas of sequences to find the value “n”, given the sum of the first “n” terms of arithmetic progressions - the “nth” term and the sum of the first “n” terms of arithmetic progressions.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Appreciate use of sequences in other subjects to understand occurring situations (in entrepreneurship and economics: Value of annuity, future value of money ...).</li> </ul>	<ul style="list-style-type: none"> <li>❖ Definition of sequences.</li> <li>❖ Arithmetic sequences. (General term, mean and sum)</li> <li>❖ Geometric sequences. (General term, mean and sum)</li> </ul>	<ul style="list-style-type: none"> <li>❖ Group led approach: Fold a piece of paper to understand the meaning of geometric sequences, and think about what should be the last term when n approaches the infinity:</li> </ul>	

<p>sum of the first “n” terms of arithmetic progressions.</p> <ul style="list-style-type: none"> <li>❖ Define and Explain geometric progressions and their properties.</li> <li>❖ Determine the value of “n”, given the sum of the first “n” terms of geometric progressions.</li> <li>❖ Show how to apply formulas to determine specific terms, the “nth” term and the sum of the first “n” terms of geometric progressions.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Explore the convergence and the divergence of sequences.</li> <li>❖ Use basic concepts and formulas of sequences to find the value “n”, given the sum of the first “n” terms of arithmetic progressions - the “nth” term and the sum of the first “n” terms of geometric progressions.</li> <li>❖ Apply the concepts of sequences to solve problems involving arithmetic and geometric sequences.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Show concern on, patience, mutual respect, tolerance, and curiosity to discuss about sequences and their applications.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Applications of sequences: <ul style="list-style-type: none"> <li>• Problems including population growth.</li> <li>• Problems including compound and simple interests.</li> </ul> </li> </ul>	 <p style="text-align: center;"> <math>\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \dots, \frac{1}{2^n}</math> </p> <ul style="list-style-type: none"> <li>❖ Group investigation: If the bank rates increase or decrease unexpectedly, discuss or investigate how will be the situation in the next n- years.</li> </ul>
<p><b>Links to other subjects:</b> <i>Geography in Demography, Entrepreneurship and Economics</i></p>				
<p><b>Assessment criteria:</b> <i>Apply arithmetic and geometric sequences to solve problems related to daily life situations</i></p>				
<p><b>Materials:</b> <i>Graph papers, manila papers, digital technology including calculators,...</i></p>				

## 5.4 Mathematics syllabus units for Senior Six

### 5.4.1 Key competences for end of Senior Six

After completion of Senior Six subsidiary- Mathematics Topics, learners from LFK, HLP & HGL combinations will be able to:

- Extend understanding, analysis and interpretation of bivariate data to correlation coefficients and regression lines
- Use counting techniques to determine the number of possible outcomes of events occurring in real life.
- Determine the probability of possible outcomes of events occurring under equally likely assumptions.

### 5.4.2 Syllabus units for Senior Six

<b>Subject: Subsidiary Mathematics</b>		<b>Senior Six</b>		<b>Combinations : LFK, HLP &amp; HGL</b>	
<b>Topic Area: STATISTICS AND PROBABILITY</b>				<b>Sub Topic: DESCRIPTIVE STATISTICS</b>	
<b>Unit 1: Bi-variate statistics</b>					<b>Number of periods: 36</b>
<b>Key Unit competence:</b> Extend understanding, analysis and interpretation of bivariate data to correlation coefficients and regression lines					
Learning objectives			Content	Learning Activities	
Knowledge and understanding	Skills	Attitudes and values			
<ul style="list-style-type: none"> <li>❖ Define bi-variate data</li> <li>❖ Draw scatter diagram</li> <li>❖ Identify type of correlation on a scatter diagram</li> <li>❖ Make a frequency distribution table of collected bivariate data</li> <li>❖ Define the covariance, coefficient of correlation and regression lines.</li> <li>❖ Determine the coefficient of correlation, covariance and regression lines of bivariate</li> </ul>	<ul style="list-style-type: none"> <li>❖ Interpret the scatter diagram for bivariate data.</li> <li>❖ Analyze a scatter diagram and infer conclusion.</li> <li>❖ Apply the coefficient of correlation and standard deviation as the more convenient measure of the</li> </ul>	<ul style="list-style-type: none"> <li>❖ Appreciate the importance of regression lines and coefficient of correlation</li> <li>❖ Predict event e.g after analyzing the population growth of a given</li> </ul>	<ul style="list-style-type: none"> <li>❖ Bivariate data and Scatter diagram</li> <li>❖ Types of correlation: Positive and negative correlations</li> <li>❖ Covariance</li> <li>❖ Correlation coefficient of bivariate data</li> <li>❖ Regression lines</li> </ul>	<ul style="list-style-type: none"> <li>❖ Learners discuss in groups, the correlation between class results and rank in school for example. They investigate them; they analyze the relationship between them, and check how the coefficient of correlation reflects the amount of variability that is shared between them and what they have in</li> </ul>	

<p>data of dispersion of a given statistical series.</p>	<p>variability in the interpretation of statistical data.</p> <ul style="list-style-type: none"> <li>❖ Analyze, interpret data critically then infer conclusion</li> </ul>	<p>country, we can make a decision about the future generation.</p>	<ul style="list-style-type: none"> <li>❖ Applications: Data analysis, interpretation and prediction problems in various areas ( Business, Geography, Demography ...)</li> </ul>	<p>common. They finally infer conclusion.</p> <ul style="list-style-type: none"> <li>❖ Learners plot visually data on scatter diagram or scatter plot to represent a correlation between two variable.</li> <li>❖ Analyze the graph, infer conclusion using coefficient of correlation to make predictions about the variables studied.</li> </ul>
<p><b>Links to other subjects:</b> <i>Geography (spatial statistics research, Air pollution in different year, Demography (Population growth,...)</i></p>				
<p><b>Assessment criteria:</b> <i>Extend understanding, analysis and interpretation of bivariate data to correlation coefficients and regression lines</i></p>				
<p><b>Materials:</b> <i>Geometric instruments (ruler, T-square, compass), graph papers, digital technology including calculators</i></p>				

<b>Subject: Subsidiary Mathematics</b>		<b>Senior Six</b>		<b>Combinations : LFK, HLP&amp; HGL</b>	
<b>Topic Area: STATISTICS AND PROBABILITY</b>				<b>Sub Topic: PROBABILITY</b>	
<b>Unit 2: Counting Techniques</b>				<b>Number of periods: 48</b>	
<b>Key Unit competence:</b> Use counting techniques to determine the number of possible outcomes of events occurring in real life					
<b>Learning objectives</b>			<b>Content</b>	<b>Learning Activities</b>	
<b>Knowledge and understanding</b>	<b>Skills</b>	<b>Attitudes and values</b>			
<ul style="list-style-type: none"> <li>❖ Recognize whether repetition is allowed or not in performing a given experiment</li> <li>❖ Recognize whether order matters is to be considered for performing a given experiment</li> <li>❖ Distinguish between permutations from combinations</li> <li>❖ Explain the basic counting techniques</li> </ul>	<ul style="list-style-type: none"> <li>❖ Determine and explain expectations from an experiment with possible outcomes;</li> <li>❖ Determine the number of permutations and combinations of “r” items, taken from n items at a time.</li> <li>❖ Use counting techniques to solve related problems.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Appreciate the importance of counting techniques</li> <li>❖ Show concern on how to use the counting techniques</li> </ul>	<ul style="list-style-type: none"> <li>❖ Venn diagram</li> <li>❖ Tree diagrams</li> <li>❖ Contingency table</li> <li>❖ Multiplication principles</li> <li>❖ Arrangement/Permutations. <ul style="list-style-type: none"> <li>• Definitions and properties</li> <li>• Calculations</li> </ul> </li> <li>❖ Combinations: <ul style="list-style-type: none"> <li>• Definitions and properties</li> <li>• Calculations</li> </ul> </li> </ul>	<p>Learners will be given:</p> <ul style="list-style-type: none"> <li>▪ A mental task, and be asked to imagine that, if you are a photographer sitting a group in a row for pictures. You need to determine how many different ways you can seat the group. Learners find out.</li> <li>▪ Questions in group, and be asked about counting techniques to use for example “ In how many different ways could a committee of 3 people be chosen from a class of 25 learners? ”</li> <li>▪ A task of using the letters from their proper words and be asked to create their own words, E.g: Use letters of “ <b>LITERATURE</b>”, without a prior instructions, to create news words then give feedback.</li> </ul>	
<b>Assessment criteria:</b> Apply counting techniques in solving real daily problems					
<b>Links to other subjects:</b>					
<b>Resources:</b> Dice, coins, cards, Manila paper, graph paper, ruler, digital technology including calculators, videos for games, etc.					

<b>Subject: Subsidiary Mathematics</b>		<b>Senior Six</b>		<b>Option: LFK, HLP&amp; HGL</b>	
<b>Topic Area: STATISTICS AND PROBABILITY</b>				<b>Sub Topic: PROBABILITY</b>	
<b>Unit 3: Elementary probability</b>				<b>Number of periods: 24</b>	
<b>Key Unit competence:</b> Determine the probability of possible outcomes of events occurring under equally likely assumptions.					
<b>Learning objectives</b>			<b>Content</b>	<b>Learning Activities</b>	
<ul style="list-style-type: none"> <li>❖ Define the terms : probability, sample space and event,</li> <li>❖ Give the formula of classical probability</li> <li>❖ Explain the basic probability rules,</li> <li>❖ Distinguish mutually exclusive and non-exclusive events.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Determine and explain expectations from an experiment with possible outcomes;</li> <li>❖ Use properties of probability to calculate the number of possible outcomes of occurring events under equally likely assumptions;</li> <li>❖ Calculate the probability of an event</li> </ul>	<ul style="list-style-type: none"> <li>❖ Appreciate the use of probability as a measure of chance.</li> <li>❖ Show concern for taking or not taking risk when engaged in games of chance such as card games, betting, slot machines or lotteries.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Concepts of probability: <ul style="list-style-type: none"> <li>• Random experiment.</li> <li>• Sample space.</li> <li>• Event, complementary events, mutually exclusive events.</li> </ul> </li> <li>❖ Definition of probability of an event under equally likely assumptions.</li> <li>❖ Basic probability rules.</li> </ul>	<ul style="list-style-type: none"> <li>❖ In groups, discuss the advantages and disadvantages of betting and present the findings to the class;</li> <li>❖ Conducting the probability experiments (flipping a coin once, rolling one die once, toss two coins, answer a true or false question, rolling two dice, drawing one card from an ordinary deck of cards, gender of children for a family with 3 children, etc.) discuss possible outcomes/events.</li> <li>❖ Using real life tasks (games, number of trials,...) , discuss and asked to determine the probability of having a success.</li> </ul>	
<b>Assessment criteria:</b> Apply concepts of counting techniques in real life.					
<b>Links to other subjects:</b> All subjects					
<b>Resources:</b> Dice, coins, cards, Manila paper, graph paper, ruler, digital technology including calculators, videos for games, etc.					



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## ANNEXES

### Annex 1: LFK, HLP& HGL Subjects and time allocation

#### A. Literature in English– French- Kinyarwanda - Kiswahili (LFK)

Subject	Weight(%)	Number of periods		
		(Period= 40 minutes)		
		S4	S5	S6
<b>I. Core subjects/Compulsory: Examinable in National exams</b>				
1. Literature in English	14	7	7	7
2. French	14	7	7	7
3. Kinyarwanda	14	7	7	7
4. Kiswahili	12	6	6	6
5. Entrepreneurship	6	3	3	3
6. General Studies and Communication Skills	6	3	3	3
<b>Sub-total 1</b>		<b>33</b>	<b>33</b>	<b>33</b>
<b>II. Core Subjects: Examinable at School level</b>				
7. ICT	6	3	3	3
8. English	6	3	3	3
9. Subsidiary Mathematics	6	3	3	3

10. Physical Education and Sports	4	2	2	2
<b>Sub-total 2</b>		<b>11</b>	<b>11</b>	<b>11</b>
<b>III. Co-curricular activities (compulsory)</b>	12	6	6	6
<b>Total number of contact periods per week</b>	100	<b>50</b>	<b>50</b>	<b>50</b>
<b>Total number of contact hours/week</b>		<b>33.3</b>	<b>33.3</b>	<b>33.3</b>
<b>Total number of contact hours per year (39 weeks)</b>		<b>1300</b>	<b>1300</b>	<b>1300</b>

**B. History–Literature in English - Psychology (HLP)**

Subjects	Weight (%)	Number of periods		
		(Period= 40 minutes)		
		S4	S5	S6
<b>I. Core subjects/Compulsory: Examinable in National exams</b>				
1. History	14	7	7	7
2. Literature in English	14	7	7	7
3. Psychology	14	7	7	7
4. General Studies and Communication Skills	6	3	3	3
5. Entrepreneurship	6	3	3	3
<b>Sub-total 1</b>		<b>27</b>	<b>27</b>	<b>27</b>
<b>II. Core Subjects examinable at School level</b>				
6. Kinyarwanda	6	3	3	3
7. ICT	6	3	3	3
8. English	4	2	2	2
9. Physical Education and Sports	4	2	2	2
10. Subsidiary Mathematics	6	3	3	3
11. French	6	3	3	3
<b>Sub-total 2</b>		<b>16</b>	<b>16</b>	<b>16</b>
<b>III. Co-curricular activities (compulsory)</b>	14	<b>7</b>	<b>7</b>	<b>7</b>

<b>Total number of contact periods per week</b>	100	<b>50</b>	<b>50</b>	<b>50</b>
<b>Total number of contact hours/week</b>		<b>33.3</b>	<b>33.3</b>	<b>33.3</b>
<b>Total number of contact hours per year (39 weeks)</b>		<b>1300</b>	<b>1300</b>	<b>1300</b>

**C. History – Geography – Literature in English (HGL)**

Subject	Weight (%)	Number of periods (Period= 40 minutes)		
		S4	S5	S6
<b>I. Core subjects/Compulsory: Examinable in Nationalexams</b>				
1. History	14	7	7	7
2. Geography	14	7	7	7
3. Literature in English	14	7	7	7
4. General Studies and Communication Skills	6	3	3	3
5. Entrepreneurship	6	3	3	3
6. English	6	3	3	3
<b>Sub-total 1</b>		<b>30</b>	<b>30</b>	<b>30</b>
<b>II. Core Subjects examinable at School level</b>				
7. Kinyarwanda	6	3	3	3
8. ICT	6	3	3	3
9. Subsidiary Mathematics	6	3	3	3
10. Physical Education and Sports	4	2	2	2
11. French	6	3	3	3
<b>Sub-total 2</b>		<b>14</b>	<b>14</b>	<b>14</b>
<b>III. Co-curricular activities (compulsory)</b>	<b>12</b>	<b>6</b>	<b>6</b>	<b>6</b>

<b>Total number of contact periods per week</b>	<b>100</b>	<b>50</b>	<b>50</b>	<b>50</b>
<b>Total number of contact hours/week</b>		<b>33.3</b>	<b>33.3</b>	<b>33.3</b>
<b>Total number of contact hours per year (39 weeks)</b>		<b>1300</b>	<b>1300</b>	<b>1300</b>

## Annex 2: Content overview of Subsidiary Mathematics for LFK, HLP & HGL Combinations

<b>LEAVERS PROFILE</b>	<b>SENIOR 4 Units</b>	<b>SENIOR 5 Units</b>	<b>SENIOR 6 Units</b>
Apply preliminarily mathematical concepts in solving real life problems	<b>ARITHMETICS (36 Periods)</b> <ul style="list-style-type: none"> <li>❖ Basic arithmetic operations: <ul style="list-style-type: none"> <li>• fractions</li> <li>• decimals</li> <li>• percentages</li> <li>• Ratios</li> <li>• negative numbers</li> <li>• absolute value</li> <li>• powers and roots</li> <li>• decimal logarithms</li> </ul> </li> <li>❖ Applications <ul style="list-style-type: none"> <li>• Simple and</li> </ul> </li> </ul>	<b>SEQUENCES (24 Periods)</b> <ul style="list-style-type: none"> <li>❖ Definition of sequences.</li> <li>❖ Arithmetic sequences <ul style="list-style-type: none"> <li>• Definition and characteristics</li> <li>• <math>n^{\text{th}}</math> term of an arithmetic sequence</li> <li>• sum of <math>n</math> first terms of an arithmetic sequence</li> </ul> </li> <li>❖ Geometric sequences <ul style="list-style-type: none"> <li>• Definition and characteristics</li> <li>• <math>n^{\text{th}}</math> term of a geometric</li> </ul> </li> </ul>	<b>COUNTING TECHNIQUES ( 42 Periods)</b> <ul style="list-style-type: none"> <li>❖ Venn diagram</li> <li>❖ Tree diagrams</li> <li>❖ Contingency table</li> <li>❖ Multiplication principles</li> <li>❖ Arrangement/Permutations. <ul style="list-style-type: none"> <li>• Definitions and properties</li> <li>• Calculations</li> </ul> </li> <li>❖ Combinations: <ul style="list-style-type: none"> <li>• Definitions and properties</li> <li>• Problem solving</li> </ul> </li> </ul>



	<p>compound interest</p> <ul style="list-style-type: none"> <li>• Final value of investment</li> <li>• Arc of elasticity of demand.</li> </ul>	<p>sequence</p> <ul style="list-style-type: none"> <li>• sum of n first terms of a geometric sequence</li> </ul> <p>❖ Applications of sequences:</p> <ul style="list-style-type: none"> <li>• Problems including population growth.</li> <li>• Problems including compound and simple interests.</li> </ul>	
	<p><b>EQUATIONS AND INEQUALITIES (36 periods)</b></p> <p>❖ Linear equations in one unknown</p> <p>❖ and inequalities in one unknown</p> <ul style="list-style-type: none"> <li>• <i>Meaning of inequalities</i></li> <li>• <i>Intervals</i></li> <li>• <i>Inequalities of products/quotients</i></li> <li>• <i>Real life problems involving linear inequalities</i></li> </ul> <p>❖ Simultaneous linear equations with two variables</p> <p>❖ Quadratic equations</p>	<p><b>FUNCTIONS AND GRAPHS (24 periods)</b></p> <p>❖ Generalities on numerical functions:</p> <ul style="list-style-type: none"> <li>• Definitions</li> <li>• Domain and range</li> <li>• Parity of a function (odd or even)</li> </ul> <p>❖ Graphical representation of linear and quadratic functions</p> <p>❖ Interpretation of functions in Economics and finance:</p> <ul style="list-style-type: none"> <li>• Supply function</li> <li>• Demand functions</li> <li>• Revenue function</li> </ul>	

	<p>(factorization and use of discriminant)</p> <ul style="list-style-type: none"> <li>❖ Applications of linear and quadratic equations in economics and finance: Problems about supply and demand, finance, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• cost functions</li> <li>• Profit functions</li> </ul>	
Analyze and interpret statistical data from daily life situations	<p><b>DESCRIPTIVE STATISTICS (36 periods)</b></p> <ul style="list-style-type: none"> <li>❖ Definition and type of data</li> <li>❖ Data presentation</li> <li>❖ Graph interpretation</li> <li>❖ Measures of central tendency: mode, mean, median</li> <li>❖ Measures of dispersion: Range, Quartiles, Variance, Standard deviation, Coefficient of variation</li> <li>❖ <i>Application: Collection, organization, presentation and interpretation of data and draw conclusions</i></li> </ul>		<p><b>BI-VARIATE STATISTICS (36 periods)</b></p> <ul style="list-style-type: none"> <li>❖ Bivariate data and Scatter diagram</li> <li>❖ Types of correlation: Positive and negative correlations</li> <li>❖ Covariance</li> <li>❖ Correlation coefficient of bivariate data</li> <li>❖ Regression lines</li> <li>❖ Spearman Rank Correlation</li> <li>❖ Applications: Data analysis, interpretation and prediction problems in various areas ( Business, Geography, Demography ...)</li> </ul> <p><b>ELEMENTARY PROBABILITY (30 periods)</b></p> <ul style="list-style-type: none"> <li>❖ Concepts of probability: <ul style="list-style-type: none"> <li>• Random experiment.</li> <li>• Sample space.</li> <li>• Event, complementary</li> </ul> </li> </ul>

			<p>events, mutually exclusive events.</p> <ul style="list-style-type: none"> <li>❖ Definition of probability of an event under equally likely assumptions.</li> <li>❖ Basic probability rules.</li> </ul>
Use mathematical logic as a tool of reasoning and decision making in daily life		<p><b>INTRODUCTION TO LOGIC (36 Periods)</b></p> <ul style="list-style-type: none"> <li>❖ Introduction and fundamental definitions <ul style="list-style-type: none"> <li>• Logic</li> <li>• Statements and negation of statements (simple and compound )</li> </ul> </li> <li>❖ Truth tables</li> <li>❖ Logical connectives and truth table <ul style="list-style-type: none"> <li>• The Negation “<b>not</b>”</li> <li>• The Conjunction “<b>and</b>”</li> <li>• The Disjunction “<b>or</b>”</li> <li>• Conditional</li> <li>• Bi-conditional or Equivalence “<b>if and only if</b>”</li> </ul> </li> <li>❖ Tautologies and Contradictions</li> <li>❖ Quantifiers and their negations <ul style="list-style-type: none"> <li>• The universal quantifier “<b>for all</b>”</li> <li>• Existence “<b>there exists</b>”</li> </ul> </li> </ul>	

		<ul style="list-style-type: none"> <li>❖ Applications: <ul style="list-style-type: none"> <li>• Hypothetical syllogism</li> </ul> </li> </ul>	
<p>Represent geometric shapes in 2D and calculate their area</p>		<p><b>POINT, LINES AND GEOMETRIC SHAPES IN 2D (24 Periods)</b></p> <ul style="list-style-type: none"> <li>❖ Points in 2D: Cartesian coordinates of a point, Distance between two points, Mid-points of a line segment.</li> <li>❖ Lines in 2D: Parametric equation and Cartesian equation given: (Direction vector , 2 points or Gradient)</li> <li>❖ Problems on points and straight lines in 2D: <ul style="list-style-type: none"> <li>• Positions (point to a line, Two lines)</li> <li>• Distance from a line to a point.</li> <li>• Geometric shapes in 2D.</li> </ul> </li> </ul>	