MATHEMATICS SYLLABUS FOR TTCs

Option: SOCIAL STUDIES EDUCATION (SSE)

YEAR 1, 2 & 3

© 2022 Rwanda Basic Education Board

All rights reserved

This syllabus is the property of Government of Rwanda.

Credit must be provided to REB when the content is quoted.

FOREWORD

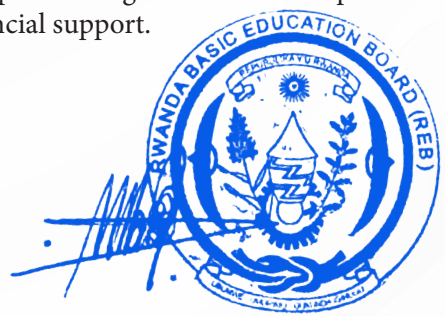
Rwanda Education Board is honoured to avail the Mathematics Syllabus for Teacher Training Colleges (TTCs) in the SSE option. This document serves as official guide to teaching and learning of Mathematics in TTCs, Pre-primary and Primary education.

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 that prepare them to be well integrated in society and exploit employment opportunities.

The ambition to develop a knowledge-based society and the growth of regional and global competition in the labor market has necessitated the shift from knowledge to competence based curriculum in TTCs. The TTC curriculum was revised to align it to the Competence-Based Curriculum for basic education to prepare teachers who are competent and confident to implement CBC in pre-primary and primary education. The rationale of the changes is to ensure that TTC leavers are qualified for job opportunities and further studies in Higher Education in different programs under education career advancement.

I wish to sincerely express my appreciation to the people who contributed towards the development of this syllabus, particularly, Consultants, REB staff, UR-CE Lecturers, TTC Tutors, Teachers from general education and experts from Local and international Organizations for their technical support. A word of gratitude goes to the Head Teachers and TTCs principals who availed their staff for various revision activities.

Special appreciation goes to the Development Partners such as UNICEF, USAID/Soma Umenye, Save the Children and Right To Play for their financial support.



Dr. MBARUSHIMANA Nelson

Director General

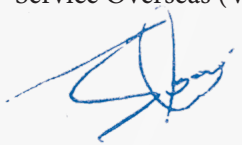
ACKNOWLEDGEMENT

I wish to sincerely express my special appreciation to the people who played a major role in development of Mathematics syllabus in SSE option. It would not have been successful without the support from different education stakeholders. My thanks first go to the leadership of UR-CE who started the review of the TTC curriculum in 2015.

I wish also to thank Rwanda Education Board (REB) leadership who continued and supervised the curriculum review process. I wish to extend my appreciation to Consultants, REB staff, Lecturers from UR-CE, TTC principals, TTC Directors of Studies deputy principals, tutors, teachers from secondary general Education and whose efforts during the revision process were much valuable.

Special thanks go to UNICEF who funded the development, designing finalization and printing of this syllabus.

I owe gratitude to different education partners more especially USAID-Soma Umenye, Save the Children, Right To Play, Help a Child, Aegis Trust,Humanity and Inclusion, Flemish Association for Development Cooperation and Technical Assistance (VVOB), Voluntary Service Overseas (VSO), Teach Rwanda and IEE for their technical support



Joan Murungi,

Head of **Curriculum Teaching and Learning Resources Department/REB**

TABLE OF CONTENTS

FOREWORD iii

ACKNOWLEDGEMENT iv

1. GENERAL INTRODUCTION 1

1.1. Rwanda Education Sector Objectives 1

1.2. Level Competences of Primary Teacher Education in the Republic of Rwanda 1

1.3. Background to curriculum review 2

1.4. Rationale of teaching and learning mathematics 3

1.4.1. Mathematics and the society 3

1.4.2. Mathematics and student-teachers 3

1.5. Professional standards and Competences 4

1.5.1. Competences 4

1.5.2. Teaching professional standards 4

1.5.3. Broad Mathematics competences 6

1.5.4. Mathematics and developing competences 6

2. PEDAGOGICAL APPROACH 7

2.1. Role of the student-teacher 7

2.2. Role of the tutor 8

2.3. Special Needs Education and Inclusive Education Approach 8
2.4. Skills Laboratory in Mathematics 9
3. ASSESSMENT APPROACH 11
3.1. Types of assessments 11
3.1.1. Formative assessment 12
3.1.2. Summative assessments 12
3.2. Record keeping 12
3.3. Item writing in summative assessment 13
4. RESOURCES 14
4.1. Materials needed for implementation 14
4.2. Human resource 14
5. SYLLABUS UNITS 15
5.1. Mathematics units for year one 15
5.1.1. Key Competences at the end of year one 15
5.1.2. Mathematics Syllabus units for year one 16
5.2. Mathematics units for year 2 23
5.2.1. Key competences at the end of year two 23
5.2.2. Mathematics Syllabus units for Year Two 24
5.3. Mathematics units for year 3 29

5.3.1. Key competences at the end of year 3 29
5.3.2. Mathematics Syllabus units for year three 30
REFERENCE 34
ANNEXES 36
Annex 1: Overview of mathematics for SSE 36
Annex 2: TTC Subjects and time allocation 39

1. GENERAL INTRODUCTION

1.1. Rwanda Education Sector Objectives

The Education Sector objectives are the reference point for the inclusion of education issues into other Rwandan policy documents. These objectives are aligned with those recommended in the Eastern African Curriculum Framework proposals. The Government of Rwanda through law number 36/2018 of 29th June, 2018, determining the organization of education, revised the objectives of the sector. They are to:

1. Provide Rwandans with adequate skills at all levels of general, professional as well as technical and vocational education;
2. Offer quality courses and education at all levels;
3. Promote science, technology and research in order to equip many Rwandans with capacity to speed up national development;
4. Promote the culture of peace, tolerance, justice, respect for human rights, solidarity, democracy and that of avoiding any form of discrimination or favoritism;
5. Provide each Rwandan with an integrated education based on ethical values, science and social welfare and directed towards building a nation to ensure its sustainable development.
6. Instil into Rwandans the love of a job well done, the value of hard work, punctuality and promotion of competence.
7. Train Rwandans to have freedom of thought, be innovative, have abilities to acquire and be analytical towards other people's opinions and to communicate his or her own ideas, to be patriotic and encourage him or her to be updated on the situation prevailing elsewhere;
8. Eliminate all grounds and obstacles that hinder the development of girls and women education as well as of any other groups that need special attention.

These objectives and associated strategies are the backbone for developments in education including the curriculum and assessment policy and the curriculum framework.

1.2 Level Competences of Primary Teacher Education in the Republic of Rwanda

As stated earlier, Pre-primary and Primary Teacher Education is under the responsibility of Rwanda Education Board. The following are the competences of Teacher Education. By the time a student teacher is exiting the college after three years he or she should:

- be a qualified teacher who can compete not only locally but regionally and internationally;
- have professional ethics and develop an inquiring mind for innovative education;
- be prepared adequately for efficiency in education, administration, management, evaluation and measurement;
- be competent, reliable, honest and responsible;
- be equipped with potentials that enable him/her to explore the learners' abilities and interests;
- be able to develop the child's ability in critical thinking, free expression and ideas.

1.3. Background to curriculum review

This Mathematics syllabus is developed for TTC student-teachers in the options of Social Studies Education (SSE).

The motive of reviewing the syllabus was to ensure that the syllabus is responsive to the needs of the student-teacher and to shift from objective and knowledge-based learning to competence-based learning. Another reason was to align the TTC curriculum to the CBC in general education. Emphasis in the review was put more on skills and competences as well as the coherence within the existing content by drawing on the previous syllabus and benchmarking with syllabi elsewhere with best practices.

The syllabus guides the interaction between the tutor and student -teachers in the learning processes and highlights the competences a student teacher should acquire during and at the end of each unit of learning. Student- teachers will have the opportunity to apply Mathematics in different contexts, and see its importance in daily life. Tutors help the student- teachers appreciate the relevance and benefits for studying Mathematics from pre/primary to tertiary levels.

The learning of student teacher is influenced by many factors such as curriculum relevancy, necessary and sufficient pedagogical approach by tutors, assessment strategies and sufficient instructional materials. With review of the Mathematics syllabus, these factors have been aligned with the competence-based curriculum for general education. This will lead to having qualified and competent teachers who are ready to implement the competence based curriculum for pre-primary and primary education. This implies equipping student teachers with relevant knowledge, skills, attitude and values necessary to make them competitive on local, regional and global job market. This revised syllabus will allow future teachers to contribute to the development of equity and quality education at pre-primary and primary levels and then it will enable student teachers to go for further studies.

1.4. Rationale of teaching and learning mathematics

Mathematics subject in the options of social studies Education (SSE) is designed to provide mathematical concepts with statistical aspects, basics of arithmetic, functions, equations and calculus which are applicable in solving simple problems in economics and other social sciences.

The syllabus concentrates on mathematical concepts that are useful tools for a student-teacher who intends to: teach in primary school, collaborate with others to solve real life problems in knowledge based economy society and undertake further studies at higher education. Topics were chosen to help the student-teacher to perform well economics lessons where mathematical concepts are essential. The mathematics content for SSE is linked to real life situations and student's experiences to enhance life skills.

1.4.1. Mathematics and the society

Mathematics plays an important role in society through abstraction counting, calculation, measurement and classification. 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 student teachers all required knowledge and skills to be used in different learning areas. Therefore, Mathematics is an important subject as it supports other subjects. This TTC Mathematics syllabus is intended to address gaps in the previous Mathematics syllabus which lacks of adequate and appropriate knowledge, skills, attitude and values.

1.4.2. Mathematics and student-teachers

Student-teachers in SSE 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 student-teachers with knowledge, skills and attitudes necessary to enable them to succeed in an era of rapid technological growth and socio-economic development. Mastery of Mathematical ideas makes student-teachers being innovative and confident in problem solving. It enables the student-teachers 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 student-teachers 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, student- teachers should gain experience of a range of ICT equipment and applications.

1.5. Professional standards and Competences

1.5.1 Competences

Competence is defined as the ability to perform a particular task successfully, resulting from having gained an appropriate combination of knowledge, skills, attitudes and values. The present syllabus provides the opportunity to student-teachers to develop different broad Mathematics competences as well as the generic competences.

Broad subject competences are highlighted and broken into key competences for each year, these are further broken into key unit competences which are finally split into learning objectives knowledge, skills, attitudes and values) in every learning unit.

Taking into account the rationale behind the overall TTC curriculum review as well as the parameters and constraints of the local context, student- teachers will be equiped with professional standards and generic competences. Professional standards are acquired through generic competences and professional practices that are emphasized and reflected in the learning process. The Mathematics tutors will ensure that student -teachers are exposed to tasks that help them acquire these competences.

1.5.2. Teaching professional standards

These refer to the characteristics that all tutors globally should have. All tutors in Rwanda should have the six characteristics listed below:

i) The teacher has knowledge of CBC and how to implement it.

The teacher has understanding of CBC and how it works. He/she has knowledge of basic and generic competences and is able to integrate the cross cutting issues within and across subject area.

ii) The teacher as an educator

The teacher enhances and stimulates cognitive, social-emotional, physical and moral development of the children. She/he therefore has a thorough understanding of the child's background, interests, motivations and problems and can adjust her/his actions and the learning environment to the different needs of the students. A competent educator is a role model, showing desired behavior and values. She/he guides and coaches her/his students to become social, self-confident, independent, responsible, open-minded and innovative people and act like a role model. In order to be educator, the student must be supported in developing cooperation, inter personal and life skills.

iii) The teacher as a subject expert

Mathematics teacher develops critical thinking skills, problem solving skills and creativity. She/he uses teaching/learning Mathematics methods and techniques that are appropriate to Mathematics in lower primary education; she/he applies Mathematics content, plan lessons integrating play-based strategies in teaching/learning. The teacher in primary education has a thorough Mathematics knowledge that enables him/her to develop the teaching/learning materials, lesson planning, to deliver the lesson and connect with her/his daily life activities in primary education using correctly the language of instruction. The teacher as Mathematics expert in upper primary education stimulates English in the teaching/learning process by considering the transition from Kinyarwanda to English as medium of Instruction in upper primary.

The teacher as subject expert knows and uses appropriate Mathematics methods/techniques to assess student teachers and give constructive feedback to the whole class. The teacher is able to link the content with other subjects and connect it with real life situations. This enables a student-teacher to acquire critical and problem solving skills as well as the mathematical concepts and skills enabling him/her to pursue tertiary education easily**.**

iv) The teacher as a communicator

The professional teacher displays a good example in his/her way of expressing him/herself, stimulates and enhances positive and clear communication between him/herself and the students, between the students, college community and the wider society. A good communicator is open-minded and respects diversity within and around the college. This requires teacher to communicate in official languages.

v) The teacher as a guide and an organizer

The professional teacher facilitates the holistic development of all students, taking into account the differences between them. She/he ensures that the learning environment (class, playground, etc.) is well maintained and conducive for learner's learning outcomes. This requires a student to be equipped with management skills.

vi) The teacher as an innovator, researcher and reflective practitioner

The professional teacher looks at ways to improve her/his teaching, and the wellbeing and results of her/his learners. She/he is a reflective practitioner and knows how to perform small-scale reflective action.

The acquisition of such skills will require students 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, thus becoming a lifelong learner.

1.5.3. Broad Mathematics competences

At the end of three years in TTC, the student teacher from the SSE option should be able to:

- Describe the role played by mathematics and appreciate its social and economic implications in daily life.
- Apply statistical skills to elaborate students' school reports, interpret them and any other statistical data from different reference books, journals and relevant scientific documents.
- Apply mathematical concepts, principles and processes in real life situations/ experiences or problem solving as well as applying them to other subjects.
- Use ICT tools (such as calculators and mathematical software) in teaching and learning Mathematics in sense of research, curiosity and creativity to explore Mathematical concepts and facts;

1.5.4. 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 students 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 student-teacher 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 student-teachers make presentations leading to inferences and conclusions at the end of each learning unit. This will be achieved through student teachers' 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 student-teacher 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 student-teacher

In the competence-based syllabus, the student teacher 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 student teacher, the syllabus suggests under each unit, some activities of the student teacher and they all reflect active participation in the learning process.

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

The following are some of the roles or the expectations from the student teachers:

- Student teachers 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 student teachers to manipulate concrete objects and to use models.
- Student teachers 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.
- Student teachers work on one competence at a time to form concrete units with specific learning objectives (knowledge, skills and attitude).
- Student teachers will be encouraged to do research and present their findings through group work activities.
- A student teacher is cooperative: student teachers work in heterogeneous groups to increase tolerance and understanding.
- Student teachers are responsible for their own participation and ensure the effectiveness of their work.

2.2. Role of the tutor

In the competence-based syllabus, the tutor is a facilitator, organizer, advisor, a conflict solver, etc.

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

Tutor is:

- A facilitator, his/her role is to provide opportunities for student-teachers 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 student-teachers 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/tutor must identify the needs of the student-teachers, 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 student-teachers in need. He/she comforts and encourages student-teachers 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 have problems such as attribution of tasks; they should find useful and constructive interventions of the teacher as a unifying element.
- Asked for help only when the whole group agrees to ask a question
- Ethical and preaches for examples by being impartial, a role-model, caring for individual needs, especially for slow student teachers 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 student teachers 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 student teachers 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 tutor therefore

is requested to consider each student teacher's needs during teaching and learning process. Assessment strategies and conditions should also be standardized to the needs of these student teachers. Detailed guidance for each category of student teachers with special education needs is provided for in the guidance for teachers. The tutor is advised to work closely with the tutor of special need education to provide appropriate support to any identified student -teacher's needs.

2.4. Skills Laboratory in Mathematics

Mathematics is a practical subject in which student teachers can learn and explore various mathematical concepts , verify different mathematical facts and theories using a variety of practical activities and material. The use of mathematics laboratory helps to integrate theory and practical work in mathematics teaching and learning where students 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:

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

Skills Lab in Mathematics makes a moment in which the student 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 students, 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 students to participate in the classroom where the vague theories and imaginary objects of mathematics take real shape which facilitates students to understand and perform better.

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

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

Role of the student teacher 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 modeling, 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 modeling: connect mathematics that have been leant to the real life situations, enhance understanding of key mathematical concepts and methods, as well as developing competences. Students 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, analyzing parts and whole, identifying patterns and relationships, induction, deduction, generalizing, and spatial visualization.

Heuristics: rules of thumb of what students 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 student teachers 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, students build the knowledge and understanding, practice acquired skills and present the findings from their researches.

The following are tasks for the students: 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 students combine the competencies 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 students to ensure practical application of the competencies acquired.

3. ASSESSMENT APPROACH

Assessment is the process of evaluating the teaching and learning processes through collecting and interpreting evidence of individual student-teacher's progress in learning and to make a judgment about a student-teacher's achievements measured according to the defined standards. Assessment is an integral part of the teaching and learning process. In the new competence-based curriculum, the assessment must also be competence-based; whereby a student-teacher 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 student- teacher demonstrate an understanding of the Mathematics concept? Has the student- teacher mastered the Mathematics concepts? Indicators: correctness of answers, coherence of ideas, logical reasoning, use correctly mathematical symbols and concepts, etc.
- Practical skills: How does the student-teacher perform on aptitude and practical tests? Indicators: accuracy, using appropriate methods, quality product, speed and efficiency, coherence.
- Attitude and values: How does the student-teacher respond to a task or a situation? What is the student-teacher's behavior? How the student-teacher 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 tutor 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 tutor should ensure that all the student teachers have mastered the stated key unit competences basing on the criteria stated, before going to the next unit. The tutor will assess how well each student-teacher masters both the subject and the generic competences described in the syllabus as well as the professional practices. From this, the tutor will gain a picture of the all-round progress of the student-teacher. The tutor 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 student teacher, it serves a summative purpose. Summative assessment gives a picture of a student teacher's competence or progress at any specific moment. The main purpose of summative assessment is to evaluate whether competences have been achieved and to use the results for ranking or grading of student teachers, for deciding on progression, for selection into the next level of education and for certification. This assessment should have an integrative aspect whereby a student must be able to show mastery of all competences. It can be internal College based assessment or external assessment in the form of national examinations. College based summative assessment should take place once at the end of each term and once at the end of the year. College 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 student's transcript.

3.2. Record keeping

This is gathering facts and evidence from assessment instruments and using them to judge the student'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 student-teacher. 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 professional practice of the student-teacher at the end of the college.

This portfolio is a folder (or binder or even a digital collection) containing the student-teacher's work as well as the student-teacher'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 student learning. Besides, it will serve as a verification tool for each student-teacher 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/equipments needed in the learning and teaching process:

- Materials to encourage group work activities and presentations: Computers (XO laptops, 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.

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 tutors.

4.2. Human resource

The effective implementation of this curriculum needs a joint collaboration of educators at all levels. Given the required material, tutors 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 TTCs for a successful implementation. On the other hand, TTC principles and TTC deputy principals 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 student-teachers as well as the contemporary development of the country.

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

5. SYLLABUS UNITS

5.1 Mathematics units for year one

5.1.1 Key Competences at the end of year one

After completion of year one Social Studies Education, the Mathematics syllabus will enable the student-teacher to:

1. Apply arithmetic operations to solve simple economic problems
2. Model and solve daily life problems using linear, quadratic equations or inequalities;
3. Apply graphical representation of function in Economics models
4. Evaluate correctly limits of functions and apply them to solve related problems
5. Use the concepts of calculus to solve and interpret related problems in various contexts
6. Analyze and interpret statistical data from daily life situations
7. Use combinations and permutations to determine probabilities of occurrence of an event

5.1.2 Mathematics Syllabus units for year one

Subject: Mathematics	**YEAR ONE**	**OPTION: SSE**
Topic Area: ALGEBRA	**Sub Topic: Sub-topic Area: NUMBERS AND OPERATIONS**	
Unit 1:ARITHMETICS		**No. of periods: 14**
Key Unit Competence: Apply arithmetic operations to simple economic problems		

Learning objectives			**Content**	**Teaching/ Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Define a power , fraction, decimal number, a decimal logarithm, roots, negative number and the absolute value of a real number – Identify properties of powers, roots, decimal logarithms and absolute value	– Classify the types of fraction. – Illustrate each property of a power, an exponential ,a radical, a logarithm, the absolute value of a real number – Transform a logarithmic expression to equivalent power form and vice versa – Rewrite an expression containing – "absolute value" using order relation – Apply arithmetic operations to simple economic problems.	– Appreciate the importance and the use of basic arithmetic. – Show curiosity for the study of application of arithmetic operations to simple economics problems	– Basic arithmetic operations: the use of brackets, fractions, decimals, percentages, negative numbers, absolute value, powers, roots and decimal logarithms. – Apply arithmetic operations to simple economic problems: – Elasticity of demand.	– Individually, student-teachers brainstorm the definition and properties of powers , decimal logarithm, roots and absolute value – In groups, student-teachers are asked to Make research in advance in the library/ internet about Basic arithmetic operations and apply arithmetic operations to simple economic problems

Assessment criteria: be able to apply arithmetic operations to simple economic problems
Link to other subjects: *Entrepreneurship and Economics*
Resources: Manila papers, flash cards.

Subject: Mathematics	YEAR ONE	OPTION: SSE
Topic Area: ALGEBRA	Sub Topic: Sub-topic Area: EQUATIONS AND INEQUALITIES	
Unit 2: Equations and inequalities		No. of periods: 15
Key unit Competence: Model and solve daily life problems using linear, quadratic equations or inequalities		

Learning objectives			Content	Teaching/ Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– List and clarify the steps in modeling a problem by linear equations and inequalities – Define equations and inequality – List the steps of solving daily life problems using linear, quadratic equations or inequalities	– Solve graphically and algebraically linear equations and inequalities to model a given situation – Solve equations and inequalities in one unknown. – Solve simultaneous equations by using different methods. – Solve economic problems that involve quadratic functions – Apply equations and inequalities in solving daily life problems related with economics and other social sciences.	– Appreciate the importance of linear equations and inequalities in a given situation – Show the curiosity of the applications of equations and inequalities in economics	– Equations and inequalities in one unknown • Simultaneous linear equations with two or more variables • Solving quadratic equations (factorization and discriminant) – Applications: Economics (Problems about supply and demand analysis, …)	– In groups, student-teachers discuss on the importance and necessity of linear equations and inequalities and how it takes place in the trade – In pairs, student-teacher solve linear equations and simultaneous equations. – Student-teachers brainstorm the use of equations and inequalities in economics and other social sciences.

Assessment criteria: *Model and solve algebraically or graphically daily life problems using linear, quadratic equations or inequalities*
Link to other subjects: *Entrepreneurship and Economics*
Resources: *Geometric instruments (ruler-square ....), Digital technology including calculator,...*

SUBJECT: MATHEMATICS	YEAR One	Option : SSE
Topic Area: ANALYSIS	Sub-topic Area: FUNCTIONS	
Unit3:Graphs and functions		Number of periods: 15

Key unit Competence: Apply graphical representation of function in Economics models

Learning objectives			Content	Teaching/ Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Identify a function as a rule and recognize rules that are not functions – Determine the domain and range of a function – Find if the function is even or odd – Demonstrate an understanding of Graphical representation of linear, composite and quadratic functions	– Perform operations on functions – Apply different properties of functions to model and solve related problems in various practical contexts. – Draw graphs that correspond to linear and composite functions.Find the slopes of linear functions and tangents to non-linear function by graphical analysis.Use the slope of a linear demand function to calculate point elasticity. – Interpret the meaning of functions with two independent variables. – Sum marginal revenue and marginal cost functions horizontally to help in finding solutions to price discrimination and multi-plant monopoly problems	– Appreciate and explain the importance of functions to economics and other social sciences. – Show the curiosity on the interpretation of functions in Economics.	Generalities on numerical functions: • Definitions • Domain and range • Parity of a function (odd or even) – Graphical representation of linear, composite and quadratic functions – Interpretation of functions in Economics: – A linear demand functions and point elasticity. Marginal revenue, marginal cost functions, solutions to price discrimination and multi-plant monopoly problems	– In pairs, student-teachers perform the operation on functions – In pairs, student-teachers use different properties of function to solve related problems in economics and other social sciences. – Students-teacher brainstorm the steps of graphing and interpretation of function relating to linear demand functions, point elasticity, marginal revenue, marginal cost functions, solutions to price discrimination and multi-plant monopoly problems

Links to other subjects: *Economics , Entrepreneurship, geography*

Assessment criteria: Apply graphical representation of function in Economics models

Materials: *Pair of compasses, Graph Papers, ruler, Digital technology (including calculators…)*

SUBJECT: MATHEMATICS	YEAR One	Option : SSE
Topic Area: ANALYSIS	**Sub-topic Area: LIMITS, DIFFERENTIATION AND INTEGRATION**	
Unit 4: Limits of functions		**Number of periods: 13**
Key unit Competence: Evaluate correctly limits of functions and apply them to solve related problems		

Learning objectives			Content	Teaching/ Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Define the concept of limit for real-valued functions of one real variable Extend this concept to determine the asymptotes of the given function.	– Evaluate the limit of a function. – Perform operations on limits. – solve problems involving limits of economic models	– Show the curiosity of using the concept of limits – Appreciate the importance of limits in economics and other social sciences as well as in predictions	Concepts of limits: – Neighborhood of a real number • Limit of a variable • Definition and graphical interpretation of limit of a function • One-sided limits • Limits of functions at infinity. • Operations on limits • Indeterminate cases – Applications: • Continuity of a function at a point or on interval I • Asymptotes Problems involving limits of economic models.	– In pairs, student-teachers brainstorm definition of limit for real valued function – With gallery walk, student-teachers evaluate the limits of function. – In groups, student-teachers make operations on limits and apply them in solving problems involving limits of economics model.

Links to other subjects: *Economics , Entrepreneurship, geography*

Assessment criteria: *Evaluate correctly limits of functions and apply them to solve related problems*

Materials: *Manila papers, Graph Papers, ruler, markers, Digital technology,…*

SUBJECT: MATHEMATICS			YEAR One	Option : SSE
Topic Area: ANALYSIS			**Sub-topic Area: LIMITS, DIFFERENTIATION AND INTEGRATION**	
Unit 5: Derivative of functions and their applications				**Number of periods:15**
Key unit Competence: Use the concepts of derivative to solve and interpret related problems in various contexts				
Learning objectives			**Content**	**Teaching/ Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– List the rules of differentiation. – Define concept of derivative. – Distinguish between techniques of differentiation to use in an appropriate context.	– Evaluate derivatives of functions using the definition of derivative. – Use differentiation rules to find out derivatives of function and apply them for variations of functions. – Evaluate differentiation from first principles to find out the gradient at a point. – Apply differentiation in economics and other social sciences	– -Appreciate the use of gradient as a measure of rate of change (economics) – Show concern on derivatives to help in the understanding of situation (Entrepreneurship, production in a factory) – Show the curiosity on the use of differentiation in economics and other social sciences	– Concepts of derivative of a function: • Definition • the slope of a function using differentiation • High order derivatives – Rules of differentiation – Applications of differentiation : • Variations of functions • The Depreciation Function • Minimization of Average cost or total cost and Maximization of total revenue, the total profit. • Marginal revenue and marginal cost functions related to the slopes of the corresponding total revenue and cost functions. • •Point elasticity for non-linear demand functions. • Sales tax that will maximize tax yield.	– Through Group discussion, student-teachers determine the gradient of different functions at a given point using definition of derivatives, first principles, and chain rule and interpret the results. – In pairs, student-teachers represent on graph papers the gradient of a straight line and interpret it geometrically in various practical problems. – In pairs, student-teachers apply differentiation in economics and other social sciences by solving related problems.
Links to other subjects: *Economics , Entrepreneurship, geography*				
Assessment criteria: *Use the concepts of derivatives to solve and interpret related problems in various contexts*				
Materials:*Manila paper, flash card graph paper, digital technology including calculators ...*				

SUBJECT: MATHEMATICS			YEAR: One	Option : SSE
Topic Area: STATISTICS AND PROBABILITY			Sub-topic Area: DESCRIPTIVE STATISTICS	
Unit 6: DESCRIPTIVE STATISTICS				Number of periods: 15
Key Unit Competence: Analyze and interpret statistical data from daily life situations				
Learning objectives			**Content**	**Teaching/ Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Define data, measures of central tendency and measures of dispersion(variability) – – -Select measures of central tendencies and measures of dispersion.	– Determine the measures of central tendency and dispersion of a given statistical series. – Apply and explain the standard deviation as the more convenient measure of the variability in the interpretation of data Express the coefficient of variation as measure of the spread of a set of data as a proportion of its mean.	– Appreciate the use of measures of central tendency and dispersion in interpretation of data in real life. – Show concern on how to use the standard deviation as measure of variability of data. – Show the curiosity of applying measures of central tendency and dispersion in real life situation.	– Data and data presentation – Graph interpretation – Measures of central tendencies: mode, mean, median, range – Measures of dispersion: Quartiles, Variance , Standard deviation, Coefficient of variation – Application: – Collection, organization, presentation and interpretation of data and draw conclusions	– In group, student-teachers are asked to discuss about the measures of central tendency and dispersion then share their findings to other group. – In pairs, student-teachers represent data on graph papers, interpret them and infer conclusion. – Make a research on problems arising from various situation in daily life, investigate them to include the standard deviation, and represent their findings.
Links to other subjects: *Economics, geography, finance*				
Assessment criteria: *Analyze and interpret data arising from problems and questions in daily life to include the standard deviation.*				
Materials: *Manila papers, flash cards, Graph Papers, ruler, digital technology including calculators …*				

SUBJECT: MATHEMATICS		YEAR One	Option : SSE
Topic Area: STATISTICS AND PROBABILITY	Sub-topic Area: COMBINATORIAL ANALYSIS AND PROBABILITY		
Unit 7: Elementary probability			Number of periods: 21
Key unit Competence: Use combinations and permutations to determine probabilities of occurrence of an event			

Learning objectives			Content	Teaching/ Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
– Define the combinatorial analysis – Define factorial notation and recognize that for n different items there are different permutations and combinations – Construct Pascal's triangle to binomial expansion theorem – Distinguish between permutations and combinations – Define notion, axioms of probability and explain probability as a measure of chance – Distinguish between mutually exclusive and non-exclusive events and compute their probabilities	– Determine the number of permutations and combinations of "n" items, "r" taken at a time. – Use counting techniques to solve related problems in economics and other social sciences. – Use and apply elementary properties of probability to calculate the number possible outcomes of occurring event under equally likely assumptions in economics and other social sciences – Determine and explain expectations from an experiment with possible outcomes	– Appreciate the importance and the use of counting techniques in solving related problems in economics and other social sciences. – Appreciate the use of probability as a measure of chance – Show curiosity in calculating possible outcomes of occurring event under equally likely assumptions – Appreciate the importance of probability in economics and other social sciences.	– Concepts of probability: Random experiment, Sample space, Event, Probability of event – Counting techniques: Venn diagram, Tree diagrams, Contingency table, Multiplication principles, Arrangements with or without repetition, Permutations with or without repetition, Combination: Definitions and properties, Pascal's triangles, Binomial expansion – Determination of the probability of events: formula and properties, probability of mutually exclusive or non exclusive events and the addition rule, probability of independent events and the multiplication rule	– In group of three, student-teachers are given task to determine how many different ways they can seat in the group. – In pairs, student-teachers are given flash cards with different letters and asked to find out how many words can be formed without a prior instructions, then share to other groups. – In pairs, student- teachers identify different formulae related to permutations and combinations and deduce Pascal's triangle. – In groups, student-teachers make a research on problems arising from various situation in daily life, investigate the use

	– Compute expectations and determine the probability of events arising from an experiment with a number of possible outcomes in economics and other social sciences		– Examples of Events in social sciences and determination of related probability	of combinations and permutations to determine probabilities of occurrence of an event in economics and other social sciences.
Links to other subjects: economics				
Assessment criteria: Use combinations and permutations to determine probabilities of occurrence of an event				
Materials: Deck cards, coins, manila papers, markers				

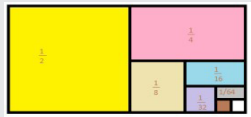
5.2 Mathematics units for year 2

5.2.1 Key competences at the end of year two

After completion of year two of Social Studies Education, the Mathematics syllabus will enable the student-teacher to:

1. Apply arithmetic and geometric sequences to solve problems in financial mathematics
2. Solve equations involving logarithms or exponentials and apply them to model and solve related problems.
3. Use matrices and determinants of order 2 and 3 to solve other related problems such as organization of data in a shopping, in Cryptography situation
4. Extend understanding of analysis and interpretation of bivariate data to correlation coefficients and regression lines
5. Apply rules of probability to solve problems related to dependent and independent events

5.2.2 Mathematics Syllabus units for Year Two

<table>
<tr><td colspan="3">SUBJECT: MATHEMATICS</td><td>YEAR Two</td><td>Option : SSE</td></tr>
<tr><td colspan="3">Topic Area: ALGEBRA</td><td>Sub-topic Area:</td><td>NUMBER PATTERNS</td></tr>
<tr><td colspan="4">Unit 1: Sequences and series</td><td>Number of periods: 21</td></tr>
<tr><td colspan="5">Key unit Competence: Apply arithmetic and geometric sequences to solve problems in financial mathematics</td></tr>
<tr><td colspan="3">Learning objectives</td><td rowspan="2">Content</td><td rowspan="2">Teaching/ Learning Activities</td></tr>
<tr><td>Knowledge and understanding</td><td>Skills</td><td>Attitudes and values</td></tr>
<tr><td>– Define a sequence and understand arithmetic progressions with their properties
– List areas of applications of sequence and series
– Show why sequence and series are very crucial in economics</td><td>– Use basic concepts and formulas of sequences to find the value n terms.
– Calculate the sum of the first “n” terms of arithmetic progressions - the “n^{th}” term and the sum of the first “n” terms of geometric progressions
– Apply the concepts of sequences to solve problems involving arithmetic and geometric sequences.</td><td>– Appreciate the relationship between the sequences and other subjects to understand occurring situations (in Economics: Value of annuity, future value of money …)
– Show concern on, patience, mutual respect, tolerance and curiosity to discuss about sequences and their applications.</td><td>– Arithmetic sequences and series
– Geometric sequences and series
– Applications:
• Final sum, the initial sum, the time period and the interest rate for an investment.
• Calculation of the Annual Equivalent Rate for part year investments and compare this with the nominal annual rate of return.
• Calculation of the value of an annuity.
• Calculation of monthly repayments and the APR for a loan.</td><td>– In groups, student-teacher do activity of folding a piece of paper to make them understand the meaning of geometric sequences , and think what should be the last term to the infinity
 
½,¼, ½, $1/2^n$
– Group activity : Bank rates increase or decrease unexpectedly, discuss or investigate how in the next n- years they come out ahead the deal stays fair
– In pairs, student-teachers are given problems related to the application of sequence and series to solve them.</td></tr>
<tr><td colspan="5">Links to other subjects: Demography in Population growth Problems, Economics in Compound and simple interests</td></tr>
<tr><td colspan="5">Assessment criteria: Apply arithmetic and geometric sequences to solve problems in financial mathematics</td></tr>
<tr><td colspan="5">Materials: Geometric instruments (ruler, T-square, compass), graph papers, digital technology including calculators, manila paper,…</td></tr>
</table>

SUBJECT: MATHEMATICS	YEAR: Two	Option : SSE
Topic Area: ALGEBRA	**Sub-topic Area: EQUATIONS AND INEQUALITIES**	
Unit 2: Logarithmic and exponential equations		**No. of lessons: 21**
Key unit Competence: Solve equations involving logarithms or exponentials and apply them to model and solve related problems.		

Learning objectives			Content	Teaching/ Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Define logarithm or exponential equations using properties of – logarithms in any base – State and demonstrate of logarithmic properties and exponent properties – Show the link between logarithm or exponential expressions to economics and other social sciences	– Apply logarithms or exponential properties to solve rates problems, mortgage problems, population growth problems – Use the exponential function and natural logarithms to derive the final sum, initial sum and growth rate when continuous growth takes place. – Solve logarithmic and exponential equations involving economics and other related social science	– Appreciate the use of logarithmic and exponential equations to model and solve problem involving Interest rates problems, mortgage problems ,population growth problems, earthquake problems – Show patience, mutual respect and tolerance to solve logarithmic or exponential equations involving economics and other social science problems – Show curiosity to solve logarithmic and exponential equations involving economics and other social science problems	– Logarithmic equations, including natural logarithms. – Exponential equations – Applications: Final sum, initial sum and growth rate when continuous and discrete growth take place: • Interest rates problems • Mortgage problems , • Population growth problems • Earthquake problems	– Through groups, the student-teachers discuss the steps for solving logarithms and exponential equations – In pairs, student-teachers are asked to apply logarithms and exponentials on given problems related to economics and other social sciences. – In groups, student-teachers make a research on the properties of logarithms, exponent properties, the solved problems of logarithms and exponential equations involving economics and other social science
Links to other subjects: *Demography (Population growth Problems), Economics (Interest rates problems, annuity value of money), etc.*				
Assessment criteria: *Apply concepts of logarithmic and exponential equations to solve problems involving logarithms or exponentials.*				
Materials: *Geometric instruments (ruler, T-square, compass), graph papers, digital technology including calculators, Manila paper…*				

SUBJECT: MATHEMATICS	YEAR: two	Option : SSE
Topic Area: LINEAR ALGEBRA	Sub-topic Area: LINEAR TRANSFORMATION IN 2D	
Unit 3: Matrices and determinants of order 2 and 3		Number of periods: 18

Key Unit Competence: Use matrices and determinants of order 2 and 3 to solve other related problems such as organization of data in a shopping, in Cryptography

Learning objectives			Content	Teaching/ Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Define order of a matrix – Define operations on matrices of order 2 and order 3 – Show that a square matrix of order 2 is invertible or not – Find the determinant of matrices of order 2 and order 3 – Give examples of order 2 and 3 matrix.	– Reorganize data into matrices – Perform operations on matrices of order 2 and 3 – Determine the determinant and inverse of matrices order 2 and 3 – Solve simultaneous equations. – Use matrices to solve problems such as organization of data in a shopping, in Cryptography	– Appreciate the importance and the use of matrices in organizing data. – Show curiosity for the study of matrices of order 2 and 3 for their applications in finding solutions of simultaneous equations. – Appreciate the application of matrices in estimating the parameters of an economic model.	– Multi-variable economic models that yield matrix forms; – Operations on matrices: • Equality of matrices • Addition • Multiplication by a scalar • Multiplication of matrices • Transpose of a matrix • Inverse of a square matrix – Determinant of a matrix of order 2 and 3: – Applications of matrices: Solution of simultaneous equations Estimating the parameters of an economic model.	– In groups, student-teachers are asked to reorganize given data into matrices and perform different operations on matrices by calculating their determinant and inverse – Student-teachers in group discuss about how a matrix of order 2 is invertible. – Individually, student-teacher make research about the importance and use of matrices in Economics and Entrepreneurship

Links to other subjects: *Entrepreneurship and in Economics(Organization of data from sales)*

Assessment criteria: *Use matrices and determinants of order 2and 3 to solve related problems*

Materials: *Manila paper, flash card graph paper, digital technology including calculators ...*

SUBJECT: MATHEMATICS			YEAR: Two	Option : SSE
Topic Area: STATISTICS AND PROBABILITY			**Sub-topic Area: DESCRIPTIVE STATISTICS**	
Unit 4: Bivariate statistics				**No. of lessons: 21**
Key unit Competence: Extend understanding, analysis and interpretation of bivariate data to correlation coefficients and regression lines				
Learning objectives			**Content**	**Teaching/ Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Define bivariate data, scatter diagram, covariance, coefficient of correlation and regression lines. – Summarize the difference between Positive and negative correlations – Give examples of data in economics involving bivariate statistics – Find measures of central tendency and variability in two quantitative variables.	– Select appropriate formulas for covariance, correlation coefficient of bivariate data, regression lines, – Positive and negative correlations and use them to calculate their values – Analyze, interpret data critically involving Business, Geography, Demography and then infer conclusion	– Appreciate the importance of using regression lines and coefficient of correlation to analyze, interpret data to infer conclusion – Show curiosity of application of bivariate statistics in data analysis, interpretation and prediction problems in economics – Show concern on calculation of covariance, correlation coefficient of bivariate data, regression lines, – Positive and negative correlations using formulas	– Bivariate data and Scatter diagram – Types of correlation: Positive and negative correlations – Covariance – Correlation coefficient of bivariate data – Regression lines – Applications: Data analysis, interpretation and prediction problems in various areas (Business, Geography, Demography …)	– Through groups, student-teacher discuss the types of correlations such as positive and negative correlation and its importance to economics. – In pairs, student-teacher make a research on calculating and use of covariance, correlation coefficient of bivariate data, regression lines, positive and negative correlations to analysis, interpretation and prediction problems in various areas the through the internet or in library and their present their findings – Through groups, student-teachers are given printed papers with the marks of different two years of national examinations in any combination to calculate the covariance, correlation coefficient, regression lines, analysis and interpretation of those two series of marks. – Through groups, student-teachers are given the activities to calculate measures of central tendency and variability in two quantitative variables.
Links to other subjects: *Geography (spatial statistics research, Air pollution in different year, Demography (Population growth,…), economics*				
Assessment criteria: *Extend understanding, analysis and interpretation of bivariate data to correlation coefficients and regression lines*				
Materials: *Geometric instruments (ruler, T-square, compass), graph papers, digital technology including calculators*				

SUBJECT: MATHEMATICS			YEAR: Two	Option: SSE
Topic Area: STATISTICS AND PROBABILITY			Sub-topic Area: PROBABILITY	
Unit 5: Conditional probability				No. of lessons: 27
Key unit Competence: Apply rules of probability to solve problems related to dependent and independent events				
Learning objectives			**Content**	**Teaching/ Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Define Dependent events and independent events – Give clear examples of Dependent events and independent events	– Extend the concept of probability to explain it as a measure of chance in economics and other social sciences. – Compute the probability of an event B occurring when event A has already taken place. – Interpret economics data to make decision about likelihood and risk in business.	– Appreciate the use of probability theorem as measure of chance in solving economics and other social sciences problems. – Show curiosity to use of Bayer's theorem to determine the probability of event B occurring when event A has already taken place in economics and other social sciences.	– Dependent events: definition, examples, Probability of event B occurring when event A has already taken place, basic formulae and properties of conditional Probability. – Independent events: definition, examples and determination of probability.	– In pairs, students –teacher discuss the difference between independent and dependent events with considering Meaning, formulas and examples – Through groups, students -teacher are given the deck of cards and arising questions involving independent and dependent events – In groups, students brainstorm the meaning of conditional probability by considering Meaning, formulas and examples – In pairs, make a research on the application of conditional probability in economics and other social sciences and present their findings to the class.
Links to other subjects: *Geography, economics*				
Assessment criteria: *Solve problems related to* dependent and independent events				
Materials: *Manila papers, ,markers, digital technology including calculators*				

5.3 Mathematics units for year 3

5.3.1 Key competences at the end of year 3

After completion of year three Social Studies Education, the Mathematics syllabus will enable the student-teacher to:

1. Apply logarithmic and exponential functions to model and solve problems about interest rates and population growth
2. Use integration as the inverse of differentiation to solve problems related to marginal and total cost
3. Use ordinary differential equations of first order to model and solve related problems in Economics

5.3.2 Mathematics Syllabus units for year three

SUBJECT: MATHEMATICS		**YEAR THREE**		**Option : SSE**
Topic Area: ANALYSIS		**Sub-topic Area: LIMITS, DIFFERENTIATION AND INTEGRATION**		
Unit 1: LOGARITHMIC AND EXPONENTIAL FUNCTIONS				**No. of lessons: 36**
Key unit Competence: Apply logarithmic and exponential functions to model and solve problems about interest rates and population growth				
Learning objectives			**Content**	**Teaching/ Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– State the restrictions on the base and the variable in a logarithmic function – Define operations on logarithmic and exponential functions in any base in the line of economics and other related science – Recall the differentiation formulas for logarithmic and exponential functions	– Calculate the domain and the range of a logarithmic and an exponential function – Calculate limits of logarithmic and exponential functions – Determine possible asymptotes of a logarithmic or an exponential function – Determine the derivative of a logarithmic or an exponential functions – Solve problems related to economics and other social sciences involving logarithms and exponential functions.	– Develop patience, dedication and commitment in solving economics problems about logarithmic and exponential functions – Show concern on use of logarithmic and exponential functions in Entrepreneurship, economics and other social sciences – Appreciate the application of logarithmic and exponential functions in determination of • Interest rates problems • Mortgage problems	– Logarithmic functions • Domain of definition • Limits of logarithmic functions and their applications to continuity and asymptotes • Differentiation and its applications – Exponential functions: • Domain of definition • Limits of logarithmic functions and their applications to continuity • and asymptotes • Differentiation and its applications	– In groups, student-teachers solve problems related to economics with the application of logarithms and exponentials functions – In groups, student-teacher evaluate the domain, limits and derivative and asymptotes of logarithmic and exponential functions to economics function – In pairs, student-teachers make research of different word problems of logarithmic and exponential functions related to economics and other social science

		– Population growth problems	• Applications of logarithmic and exponential functions: Interest rates problems, Mortgage problems and Population growth problems	
Links to other subjects: *Economics(Compounded interest), Demography (population growth)*				
Assessment criteria: be able to apply logarithmic and exponential functions to model and solve problems about interest rates and population growth				
Materials: *Graph Papers, ruler, digital technologies including calculators …*				

SUBJECT: MATHEMATICS	YEAR: THREE	Option: SSE
Topic Area: ANALYSIS	**Sub-topic Area: LIMITS, DIFFERENTIATION AND INTEGRATION**	
Unit 2: INTEGRATION		**No. of lessons: 36**

Key unit Competence: Use integration as the inverse of differentiation to solve problems related to marginal and total cost

Learning objectives			Content	Teaching/ Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Define indefinite and definite integrals. – State and clarify the relationship between derivative and anti-derivative of functions. – Illustrate the use of basic integration properties, techniques and formulas to model economics functions. – Extend the concepts of indefinite integrals to definite integrals to solve problems involving present, future Values of an Income Stream and population Growth Rates	– Select the appropriate techniques of integration. – Use integrals to solve different problems in Economics (present, future Values of an Income Stream and population Growth Rates). – Use properties, appropriate techniques and formulas of integrals to simplify the calculation of definite integrals and indefinite integrals	– Show concern on the importance of definite integrals and indefinite integral calculus in solving problems involving Economics (present, future Values of an Income Stream and population Growth Rates). – Appreciate the use of various properties, appropriate techniques and basic formulas to evaluate integrals of function and show patience, commitment and tolerance in solving related problems	– Indefinite integrals • Definition and properties • Techniques of integration: Basic Integration Formulas, Integration by change of variables, Integration by Parts – Definite integrals • Definition • Properties • Techniques of integration – Applications of definite integrals: • marginal and total cost, • consumer and producer surplus; • Present, Future Values of an Income Stream and population Growth Rates	– In pairs, student-teachers discuss the relationship between derivative and anti-derivative of functions – Through groups, student-teacher are given the printed papers with written exercises to evaluate their integrals by using different basic properties, appropriate techniques and basic formulas – Through groups, student-teachers make the research on basic properties, appropriate techniques and basic formulas of definite and indefinite Integrals

Links to other subjects: *Economics, Entrepreneurship ,geography*

Assessment criteria: Use integration as the inverse of differentiation to solve problems related to marginal and total cost

Materials: *Manila papers, Graph Papers, ruler, markers, and scientific calculator.*

SUBJECT: MATHEMATICS	YEAR THREE	Option : SSE
Topic Area: ANALYSIS	**Sub-topic Area: LIMITS, DIFFERENTIATION AND INTEGRATION**	
Unit 3: ORDINARY DIFFERENTIAL EQUATIONS		**No. of lessons: 36**
Key unit competence: Use ordinary differential equations of first order to model and solve related problems in Economics		

Learning objectives			Content	Teaching/ Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Define differential equation and classify differential equations. – Give examples of 1st Order differential equations related to economics. – State the order and the degree of an ordinary differential equation – Identify the characteristics of differential equations (first order) – Find the solution of first differential equations related to economics to predict values in basic market and macroeconomic models. – Predict the form of the particular solution of an ordinary linear differential equation of first order	– Determine whether an ordinary differential equation of first order is with separable variables, homogeneous or linear – Use appropriate method to solve an ordinary differential equation of first order related to economics and other social sciences – Solve an ordinary linear differential equation of first order by "variation of constant" and by "integrating factor" Use differential equations to model and solve problems in Economics (point elasticity,…), etc. – Discuss on the stability of economic models where growth is continuous, continuously compounded Interest and the Quantity of a Drug in the Body by using solutions of differential equations	– Appreciate the use of differential equations in solving problems continuously compounded Interest and the Quantity of a Drug in the Body – Show curiosity in solving a differential equation or modeling a problem using differential equations – Show curiosity of using solution When discussing differential equations	– Definition and classification of ODE – 1st Order differential equations • Differential equations with separable variables • Linear differential equations – Applications of ODE in Economics • Use differential equation solutions to predict values in basic market and macroeconomic models. • Comment on the stability of economic models where growth is continuous. Continuously Compounded Interest and the Quantity of a Drug in the Body	– In groups, student-teachers discuss about the meaning and classification of differential equations – In pairs, student-teachers are asked to perform the problems related to economics. – In pairs, student-teachers use graph plotting to illustrate the general solution of a differential equation. – Discuss in groups the solutions of a differential equation with respect to a parameter and present the result to the class. – In groups, make research on the applications of differential equations in economics and present findings to the class

Links to other subjects: *Economics (point elasticity and demand function),etc…*

Assessment criteria: *Student-teachers are able to Use ordinary differential equations of first to model and solve related problems Economics.*

Materials: *Geometric instruments, graph papers, calculators, ICT equipments,…*

REFERENCE

1. A. J. Sadler, D. W. S. Thorning: *Understanding Pure Mathematics*, Oxford University Press 1987.
2. Arthur Adam, Freddy Goossens and Francis Lousberg (1991). *Mathematisons 65*, DeBoeck, 3rd edition.
3. Balakrishnan, V.K . (1995). Schaum's Outline, Combinatorics.
4. Bird, J. (2003). Engineering Mathematics (4th Edition).
5. Bronson, R. (2003). Schaum's Outline, Differential equation.
6. Buxkemper, A. (2001). *Mathematics for elementary education: Preliminary edition*. New York: McGraw-Hill
7. Clements, D.H.& Sarama, J.(2009). *Learning and Teaching Early Math: The learning trajectories approach*. London: Routledge.
8. CrashwshaW,J.,& Chambers,J.(2001).Advanced Level Statistics with worked examples (Fourth Edition). Nelson Thornes Ltd:UK
9. Curriculum Planning and Development Division (2006). Secondary Mathematics Syllabuses. Ministry of Education: Singapore
10. David Rayner, *Higher GCSE Mathematics,* Oxford University Press 2000
11. Frank Ebos, Dennis Hamaguchi, Barbana Morrison & John Klassen (1990), *Mathematics Principles & Process,* Nelson Canada A Division of International Thomson Limited .
12. George B. Thomas, Maurice D. Weir & Joel R. Hass (2010), *Thomas' Calculus Twelfth Edition,* Pearson Education.
13. H.K. DASS... *Engineering Mathematics*. New Delhi, S.CHAND&COMPANY LTD, thirteenth revised edition 2007.
14. Hoffman, L.D.; Bradley, G.L.& Rosen, K.H.(2005). *Applied Calculus*. New York: McGraw-Hill.
15. J CRAWSHAW, J CHAMBERS (1984).*A concise course in A-Level statistics with worked examples*, Stanley Thornes (Publishers) LTD.
16. John, A.; Robert, G.; & Sorgenfrey (1993). *Trigonometry with application*. Boston: Houghton Mifflin Company.
17. Ministry of Education (2015). *Upper Primary level Mathematics Curriculum (P4, P5, P6).*
18. National Curriculum Development Centre (2008).Mathematics teaching syllabus: Uganda Certificate of Education Senior1-4.
19. *Pupils' Books-Grade 1-3*. Nairobi: The Jomo Kenyata Foundation.
20. Rwanda Education Board (2015). Mathematics syllabus for advanced level S4 – S6. Kigali
21. Sanchez , A.V, & Ruiz, M.P. (2008). Competence-Based Learning : A proposal for the assessment of Generic Competences(Eds).
22. Shampiyona, A. (2005). Mathématiques 6. Imprimerie de Kigali: Kigali
23. Spiegel,M. R.; Schiller, J. & Srinivasan, A. (2009). Schaum's Outline, Probability and Statistics: Third Edition.

24. *Teacher's Books-Grade 1-3.* Nairobi: The Jomo Kenyata Foundation.
25. Uworwabayeho, A. , Ndung'u, R. , Sebashumba Kamali, & Rwamanywa, N. (2010) *Primary Mathematics.*
26. Uworwabayeho, A. , Ndung'u, R. , Sebashumba Kamali, & Rwamanywa, N. (2010) *Primary Mathematics.*
27. Van de Walle, J& Lovin, H.L. (2016). *Teaching Student-centered mathematics: Grades K-3*. Volume 1. New York: Pearson Education.
28. Ngezahayo, E. P. (2016). Advanced Mathematics for Rwanda Secondary Schools. Learners' Book Senior Four. Kigali: Fountain.
29. Ngezahayo, E. P. (2017). *Advanced Mathematics for Rwanda Secondary Schools*. Learners' Book Senior Five. Kigali: Fountain.
30. Ngezahayo, E. P. (2018). *Advanced Mathematics for Rwanda Secondary Schools*. Learners' Book Senior Six. Kigali: Fountain.
31. Peter Smythe: *Mathematics HL & SL with HL options, Revised Edition*, Mathematics Publishing Pty. Limited, 2005.
32. Igbokwe DI (2000): Dominant factors and Error Types inhibiting the understanding of Mathematics. 41st Annual Conference Proceedings of STAN, 242-249.

ANNEXES

ANNEX 1: OVERVIEW OF MATHEMATICS FOR SSE

Topic area	Sub topic area	Competences		
		YEAR 1 NUMBER OF UNITS: 8	YEAR 2 NUMBER OF UNITS: 4	YEAR 3 NUMBER OF UNITS: 3
I. Algebra	1.1. **ARITHMETIC**	Apply arithmetic operations to simple economic problems		
	1.2. Equations and inequalities	Model and solve daily life problems using linear, quadratic equations or inequalities		
	1.3 Sequences and series		Apply arithmetic and geometric sequences to solve problems in financial mathematics	
II. **ANALYSIS**	2.1. **Graphs and functions**		Apply graphical representation of function in Economics models	
	2.2. **: Limits of functions**	Evaluate correctly limits of functions and apply them to solve related problems		
	2.3 Derivative of functions and their applications	Use the concepts of derivative to solve and interpret related problems in various contexts		

	2.4 LOGARITHMIC AND EXPONENTIAL FUNCTIONs		Solve equations involving logarithms or exponentials and apply them to model and solve related problems.	Apply logarithmic and exponential functions to model and solve problems about interest rates, population growth
	2.5 INTEGRATION			Use integration as the inverse of differentiation to solve problems related to marginal and total cost
	2.6 ORDINARY DIFFERENTIAL EQUATIONS			Use ordinary differential equations of first order to model and solve related problems in Economics
III. **LINEAR ALGEBRA**	3.1. **Matrices and determinants of order 2 and 3**.		Use matrices and determinants of order 2 and 3 to solve other related problems such as organization of data in a shopping, in Cryptography	
IV. **STATISTICS AND PROBABILITY**	4.1. **DESCRIPTIVE STATISTICS**	Analyze and interpret statistical data from daily life situations		
	4.2 Bivariate statistics		Extend understanding, analysis and interpretation of bivariate data to correlation coefficients and regression lines	

	4.3 : Elementary probability	Use combinations and permutations to determine probabilities of occurrence of an event		
	4.4 Conditional probability		Apply rules of probability to solve problems related to dependent and independent events	

ANNEX 2: TTC SUBJECTS AND TIME ALLOCATION

SN	Subject	Number of Periods							
		ECLPE		SSE		SME		LE	
		Y1	Y2 & 3	Y1	Y2 & 3	Y1	Y2 & 3	Y1	Y2 & 3
1	Foundations of Education	6	6	6	5	6	5	6	5
2	English	5	5	5	4	5	4	7	7
3	Kinyarwanda	5	5	2	2	2	2	5	6
4	Mathematics	3	3	3	3	6	6	2	2
5	Integrated Science	4	4	1	1	11	0	1	1
6	Physics	0	0	0	0	0	5	0	0
7	Biology	0	0	0	0	0	5	0	0
8	Chemistry	0	0	0	0	0	5	0	0
9	Social Studies	4	4	11	0	2	2	2	2
10	History	0	0	0	5	0	0	0	0
11	Geography	0	0	0	5	0	0	0	0
12	Economics	0	0	0	5	0	0	0	0
13	Creative Performance (Music and Fine Arts)	4	4	4	4	2	2	4	4
14	Physical Education	1	1	2	1	1	1	1	1
15	Entrepreneurship	2	2	2	2	2	2	2	2
16	ICT	2	2	2	2	2	2	2	2
17	TMP	7	7	4	4	6	4	4	4

18	SNE	2	2	2	2	2	2	2	2
19	Religious Education	1	1	4	3	1	1	1	1
20	French	4	4	2	2	2	2	7	7
21	Kiswahili	1	1	1	1	1	1	5	5
22	Co-Curricular	1	1	1	1	1	1	1	1
23	Individual Study	8	8	8	8	8	8	8	8
24	School Attachment	Year 3 (First term)							
	TOTAL	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**