MATHEMATIC SYLLABUS

FOR ASSOCIATE NURSING PROGRAM

SENIOR S4- S6

FOREWORD

Rwanda Basic Education Board (REB) is honored to avail the Mathematics Syllabus as one of the subjects for the Associate Nursing Program. This syllabus serves as official guide to teaching and learning of Mathematics in the Associate Nursing Program. It ensures consistency and coherence in the delivery of quality education for the Associate Nurse that the country deserves.

The Ministry of Education, through Rwanda Basic Education Board (REB, has undertaken the task to introduce the Associate Nursing Program in the second cycle of secondary education level. The underlying principle behind the introduction of this combination is to ensure that the curriculum responds to the needs of the learners, the society, and the labor 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 for quality nursing care improvement. High Quality Health Care is an important component of Health and Well-being of the Rwanda Vision 2050, "The Rwanda We Want", that aims at transforming the country's socioeconomic status. It is only the healthy people who can significantly play a major role in this socioeconomic transformation journey. Mathematics subject teaches the mathematical operations, algebraic equations, and basic statistics to train a nurse capable of successfully perform his/her duties.

I wish to sincerely appreciate all the people who contributed to the development of this syllabus, particularly the Human Resources for Health Secretariat (HRHS), in partnership with REB, who organized the whole process right from its inception.

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

Dr. MBARUSHIMANA Nelson

Director General, REB.

ACKNOWLEDGEMENTS

I wish to sincerely express my special appreciation to the people who played a role in the development of Mathematics syllabus. The process would not have been successful without the support from different stakeholders. My thanks first go to the Human Resources for Health Secretariat (HRHS) who spearhead and support the development of this syllabus.

I wish to sincerely express my appreciation to the people who contributed to the development of this syllabus until its completion. These are the HRH Secretariat staff, the Rwanda Basic Education Board (REB) staff, the University of Rwanda (UR), College of Medicine and Health Sciences, Kibogora Polytechnic (KP), Ruli Higher Institute of Health St Rose de Lima (RHIH), King Faisal Hospital, Kigali University Teaching Hospital (CHUK), Nemba District Hospital, the National Council of Nurses and Midwives (NCNM), the Rwanda Nurses and Midwives Union (RNMU), IPRC Tumba, and the Ecole Secondaire Marie Adelaide who availed their staff at various stages of the development of this syllabus.

Furthermore, I owe gratitude to different partners, especially the Ministry of Health and the Ministry of Education for their guidance, and the Clinton Health Access Initiative (CHAI) for its contribution to financial support.

Ms. MURUNGI Joan,

Head of Curriculum, Teaching and Learning Resources Department/REB

TABLE OF CONTENTS

FOREWORD ..... **iii**

ACKNOWLEDGEMENTS ..... **iv**

1. GENERAL INTRODUCTION **1**

1.1. Background on introduction of the Associate nursing Program in secondary schools 1

1.2. Associate nurse leaver's profile 2

2. TEACHING AND LEARNING MATHEMATICS **3**

2.1. Rationale of teaching and learning mathematics 3

2.2. Competences 4

2.3. Pedagogical approach 7

2.4. Assessment approach 10

2.5. Reporting to Parents 13

2.6. Resources 13

3. SYLLABUS UNITS **15**

3.1. Presentation of the structure of the Syllabus Units 15

3.2. Secondary four 16

3.3. Secondary Five 35

3.4. Secondary Six 50

4. REFERENCES **58**

5. APPENDIX: SUBJECTS AND WEEKLY TIME ALOCATION FOR ASSOCIATE NURSING PROGRAM **60**

1. GENERAL INTRODUCTION

1.1. Background on introduction of the Associate nursing Program in secondary schools

Since a long time ago, nursing education around the world has taken different steps from the traditional apprenticeship, vocational, and hospital-based training model to a higher education academic model of teaching and learning (Gaberson & Oemann, 2010). This paradigm shift was driven by the increased demand of the professionalization of nursing, the changing illness patterns, and the expansion of the knowledge-based society requiring more improved and innovative education preparation of nursing professionals that is adapted to the context and specific health needs (Yam, 2004).

In Rwanda, the above-mentioned transformations in nursing education evolved overtime. Healthcare education in general started in 1933 with medical assistants "Assistants Médicaux" program, followed by the assistant midwives "Auxiliaires accoucheuses" in 1949 (Harelimana, et., 2015). From 1954 up to 1979, there was the program at secondary level "A2 and A3". From the academic year 1979 to 2004, the program of nursing education was exclusively "A2" secondary level (Kabgayi School of Nursing and Midwifery, 2013). Nurses were mostly prepared for hospitals and health centers, leaving out the community, which was later addressed by introduction of the Community Health Workers (CHWs) in 1995 (MoH, 2012).

The Cabinet resolution of October 27th, 2004 phased out the A2 nursing program. A transition period was decided upon to move from nursing program A2 to Nursing Program A1 up to 2007. This was in the purpose to train more nursing professionals at a tertiary level in order to produce highly-qualified professionals, thus improving the quality health care delivery. However, gaps in providing basic nursing care at different levels were continually observed.

Fourteen years later, after the closure of A2 nursing program, the Government of Rwanda has decided to introduce the Associate Nursing Program in secondary education by respecting the Article 58 of the Rwandan Law Determining Organization of Education No 10/2021 of 16/02/2021 (MoE, 2021).

Associate Nursing Program is being introduced to provide the support needed in basic nursing care provision, with capacity to progress in different advanced health care professions. This decision aims to meet the current and contextual health needs that present high demand to provide the basic nursing care at different levels of the healthcare system, particularly in the community. Therefore, nursing is based on science. The hard sciences like general chemistry, general biology (Biology, microbiology, human anatomy, physiology and nutrition) physics and mathematics are required by this Associate Nursing Program as prerequisites for cornerstone preparing at earlier age of the future nurses.

1.2. Associate nurse leaver's profile

Upon completion of the Associate Nursing Program, the learner should have acquired knowledge, skills and attitudes to:

1. Provide support to individuals, families, and communities when faced with unwelcome news and life changing diagnoses;
2. Provide health education within her/his scope of practice;
3. Demonstrate understanding of the determinants of health that affect individuals, families, groups, and communities;
4. Demonstrate understanding of basic common health conditions affecting individuals of all age groups and their basic nursing care;
5. Assess individuals, families, groups and community needs and provide basic nursing care using evidence-based practice;
6. Collaborate effectively with multidisciplinary team members, clients and stakeholders in provision of basic nursing care;
7. Demonstrate values of responsibility, accountability, commitment and patriotism in serving the nation;
8. Ensure the privacy, dignity and safety of individuals is maintained at all times;
9. Provide support on basic care in reproductive, maternal, neonatal and child health;
10. Explain scientific phenomena using correct scientific terminologies;
11. Demonstrate knowledge and skills required to progress to higher learning education;

12. Express themselves fluently, and with confidence, in speaking and writing using correct vocabulary and grammar appropriately;
13. Perform experiments using a range of scientific and medical tools and equipment and draw appropriate conclusions;
14. Demonstrate ability to manage data (collect, recording, processing, analysis, synthesis, reporting) and take the appropriate decision.

2. TEACHING AND LEARNING MATHEMATICS

2.1. Rationale of teaching and learning mathematics

Mathematics plays a vital role in medicine. Since people's lives are involved, it is crucial that nurses and doctors be really accurate with their clinical calculations to ensure patient safety, data collection, data/graph analysis, and interpretation. Doctors and nurses use mathematics when they write prescriptions or administer medications. Medical professional use mathematics when drawing up and interpreting statistical graphs of epidemic or success rates of treatments and as well as in monitoring changes of patients' health.

2.1.1. Mathematics and society

Mathematics plays an important role in society through abstraction and logic, counting, calculation, measurement, systematic study of shapes and motion. It is also used in natural sciences, engineering, medicine, finance and social sciences. The applied mathematics like statistics and probability play an important role in game theory, in the national census process, in scientific research, etc. In addition, some cross-cutting issues such as financial awareness, environment and sustainability are incorporated in Mathematics to improve social and economic welfare of Rwandan society.

Mathematics is key to the Rwandan 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 new curriculum will address gaps in the current health care education in Rwanda by providing appropriate skills, attitudes, and values to associate nurses.

2.1.2. Mathematics and learners

Learners need enough basic mathematical competences to be effective members of Rwandan society including the ability to estimate, analyze, interpret statistics, assess probabilities, and read the commonly used mathematical representations and graphs.

Therefore, Mathematics equips learners with knowledge, skills and attitudes necessary to enable them to succeed in an era of rapid technological growth and socio-economic development and modern medicine. Mastery of basic Mathematical ideas and calculations makes learners being 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 Mathematics needs to include practical problem-solving activities with opportunities for students to plan their own investigations in order to develop their mathematical competence 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.

2.2. 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 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 unit 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 them acquire the skills.

2.2.1. Generic Competences

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 will help 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 will help 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, project-based works, etc.

Research: This will help learners to find answers to questions basing on existing information and concepts and to explain phenomena basing on findings from information gathered.

Communication skills: Learners effectively communicate 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 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. It is done by 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 for personal fulfillment in areas that need improvement and development.

2.2.2. Broad Mathematics Competences

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

1. Develop clear, logical, creative and coherent thinking.
2. Master basic mathematical concepts and use them correctly in daily life problem solving.
3. Express clearly, comprehensibly, correctly and precisely in verbal and/or in written form all the reasons and calculations leading to the required result whenever finding a solution to any given exercise.
4. Master the presented mathematical models and identify their applications in the learner's environment.
5. Arouse learner's mathematical interest and research curiosity in theories and their applications.
6. Use acquired mathematical skills to develop work spirit, team work, self-confidence and time management without supervision.
7. Use ICT tools to explore Mathematics (examples: calculators, computers, mathematical software…).
8. Demonstrate a sense of research, curiosity, and creativity in their areas of study.
9. Use the acquired mathematical concepts and skills to easily follow higher studies (Colleges, Higher Institutions and Universities).

2.2.3. 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 ofinformation during the learning process, the learner 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 interpretations and conclusions at the end of learning unit. This will be achieved through group work and cooperative learning which in turn will promote interpersonal relations and teamwork.

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

The selection of types of learning activities must focus on what the learners are able to demonstrate as competence throughout and at the end of the learning process.

2.3. Pedagogical approach

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

2.3.1. Role of the learner

In the competence-based curriculum, the learner is the principal actor of his/her education. He/she is not an empty bottle to fill. Considering the initial capacities and abilities of the learner, the syllabus lists under each unit, suggested activities of the learner to reflect appropriate engagement of the learner in the learning process.

The teaching- learning processes will be tailored towards creating a learner's friendly environment basing on the capabilities, needs, experience and interests. Therefore, 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, learners 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. This stimulates mathematics as it is really used, both on job and in scientific applications. Frequent use of calculators can enhance learners' understanding and mastering of arithmetic.
- Learners work on one competence at a time in form of concrete units with specific learning objectives broken down into knowledge, skills, attitudes, 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.
- Help is sought from within the group and the teacher is asked for help only when the whole group agrees to ask a question. The learners who learn at a faster pace do not the task alone and then the others merely sign off on it.
- Participants ensure the effective contribution of each member, through clear explanation and argumentation to improve the English literacy and to develop sense of responsibility and to increase the self-confidence, the public speech ability, etc.

2.3.2. Role of the teacher

In the competence-based curriculum, the teacher is a facilitator, organizer, advisor, a conflict solver, ...He/she has to ensure that cross-cutting issues are addressed appropriately in teaching and learning process.

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 discuss problems that interest and challenge them and that, with appropriate effort, they can solve. This requires an elaborated preparation to plan the activities, related learning materials and appropriate learning environment.
- He/she is an organizer: his/her role is to organize the learners in the classroom or outside and engage them through participatory and interactive methods during the learning processes as individuals, in pairs or in groups. To ensurethat 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.

- He/she is an advisor: he/she provides counseling and guidance for learners in need. He/she comforts and encourages learners by valuing their contributions in the class activities.
- He/she is a conflict-solver: most of the competence-based activities are performed in groups. The members of a group may have problems such as attribution of tasks; they should find useful and constructive the intervention of the teacher as a unifying element.
- He/she is ethical and preaches by examples, being impartial, being a role-model, and caring for individual needs of learners. Slow learners and learners with physical impairments are provided a special assistance through remedial activities or re-enforcement activities. One should notice that this list is not exhaustive.

2.3.3. Special needs education and inclusive 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. The difference can either be emotional, physical, sensory, and intellectual learning challenged traditionally known as mental retardation.

These learners equally have the right to benefit from the free and compulsory basic education in the nearby ordinary/mainstream schools. Therefore, the schools' role is to enroll them and 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 educational needs is provided for in the guidance for teachers.

2.4. 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.

Assessment will be organized at the following levels: School-based assessment, District based assessment, National based assessment and examinations.

2.4.1. Types of Assessment

a) 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 unit. Then at the end of every unit, the teacher should ensure that all the learners have mastered the stated key unitcompetences 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 and 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:

(a) observation (b) pen and paper (c) oral questioning.

b) Summative assessment

When assessment is used to record a judgment of a competence 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 learning objectives have been achieved and to use the results for the ranking or grading of learners,

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 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 each subject will be weighted and included in the final national examination grade.

School based assessment average grade will contribute a certain percentage as teachers gain more experience and confidence in assessment techniques and in the third year of the implementation of the new curriculum, it will initially contribute 10% of the final grade but will be progressively increased.

Districts will be supported to continue their initiative to organize a common test per grade for all the schools to evaluate the performance and the achievement level of learners in individual schools. External summative assessment will be done at the end of S6.

2.4.2. 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 shall generate data in the form of scores which will be carefully be recorded and stored in a portfolio because they will contribute for remedial actions, for alternative instructional strategy and feed-back to the learner and to the parents to check the learning progress and to advice accordingly or to the final assessment of the students.

This portfolio is a folder (or binder or even a digital collection) containing the student's work as well as the student'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 learner that he/she attended the whole learning before he/she undergoes the summative assessment for the subject.

2.4.3. 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 Bloom's taxonomy and the marks allocation for each question. In a competence-based assessment, 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 testing broad competences as stated in the syllabus.

2.4.4. Structure and format of the examination

There will be one paper in Mathematics at the end of S6. The paper will be composed by two sections, where the first section will be composed with short answer items or items with short calculations which include the questions testing for knowledge and understanding, investigation of patterns, quick calculations and applications of Mathematics in real life situations. The second section will be composed with long answer items or answers with constructions, more calculations, investigation of patterns and generalization, analysis, interpretation and drawing conclusions. The items for the second sectionwill emphasize on the mastering of Mathematics facts, the understanding of Mathematics concepts and its applications in real

life situations. In this section, the assessment will find out not only what skills and facts have been mastered, but also how well learners understand the process of solving a mathematical problem and whether they can link the application of what they have learned to the context or to the real-life situation.

The following topic areas must be assessed: Trigonometry; algebra; analysis; linear algebra; geometry; statistics and probability. Topic areas with more weight will have more emphasis in the second section where learners should have the right to choose to answer 3 items out of 5.

2.5. Reporting to Parents

The wider range of learning in the new curriculum means that it is necessary to think again about how to share learners' progress with parents. A single mark is not sufficient to convey the different expectations of learning highlighted in learning objectives. The most helpful reporting is to share what students are doing well and where they need to improve.

2.6. Resources

2.6.1. Materials needed for implementation of this syllabus

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

- Materials to encourage group work activities and presentations: Computers (Desk tops & lab tops) and projectors; Manila papers and markers, flipcharts, etc.
- Materials for drawing & measuring geometrical figures/shapes and graphs: Geometric instruments, ICT tools such as GeoGebra, 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, Math type, Matlab, etc

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

2.6.2. Human Resource

The effective implementation of this syllabus needs a joint collaboration of educators at all levels. Given the material requirements, teachers are expected to accomplish their noble role as stated above. On the other hand school head teachers and directors of studies are required to make a 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.

The teacher of Mathematics should have the following skills, values and qualities:

- Engage learners in a variety of learning activities
- Use multiple teaching and assessment methods, techniques and approaches.
- Adjust instruction to the level of the learners
- Have creativity and innovation in the teaching and learning process.
- Be a good communicator and organizer.
- Be a guide/ facilitator and a counsellor.
- Manifest passion and impartial love for learners in the teaching and learning process.
- Make useful link of Mathematics with other Subjects and real-life situations.
- Have a good master of the Mathematics Content.
- Have good classroom management skills.

3. SYLLABUS UNITS

3.1. Presentation of the structure of the Syllabus Units

Subsidiary Mathematics is developed to be taught and learnt in advanced level of secondary education, i.e. in S4, S5 and S6 respectively. It means that subsidiary Mathematics syllabus is developed for combinations where Mathematics is not core subject. At every grade, the syllabus is structured in Topic Areas, sub-topic Areas 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 Periods.
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 Key Competence of the unit 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 are 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 Competence Based Curriculum.*
4. Each unit has a content which indicates the scope of coverage of what to be taught and learnt in line with statedlearning 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 expectedto be used in teaching and learning process.

The Mathematics syllabus for Associate Nursing Program has 7 topic areas: Algebra, Trigonometry, Analysis, Linear algebra, Geometry, Statistics and Probability and these topic areas are found in each of the three grades of the second cycle of secondary education which are S4, S5 and S6. As for units, they are 10 in S4, 8 in S5 and 4 in S6.

3.2. Secondary four

3.2.1. Key Competences at the end of Secondary Four

After completion of secondary 4, the mathematics syllabus will help the learner to:

- Think critically to understand and perform operations on the set of real numbers.
- Use the trigonometric concepts and formulas to solve related problems in Physics, Air navigation, Water navigation, bearings, Surveying, and modern medicine.
- Model and solve algebraically or graphically daily life problems using linear, quadratic equations or inequalities.
- Use concepts and definitions of Polynomial, Rational and Irrational functions to determine their domain, represent and interpret their graphs.
- Evaluate correctly limits of functions and apply them to solve related problems
- Use differentiation to solve and interpret problems in various contexts.
- Use concepts of vectors in 2D to solve related problems such as distance, angles, …
- Use matrices and determinants of order 2 to solve problems involving the system of 2 linear equations with 2 unknowns.
- Extend understanding, analysis and interpretation of data arising from problems in daily life to the standard deviation
- Use combinations and permutations to determine the number of outcomes and the probability for an event.

3.2.2. Mathematics units for Secondary Four

<table>
<tr><td colspan="3">Topic Area: ALGEBRA</td><td colspan="2">Sub-topic Area: NUMBERS AND OPERATIONS</td></tr>
<tr><td>S4 - MATHEMATICS</td><td colspan="2">Unit 1: SET OF REAL NUMBERS</td><td colspan="2">Number of Periods: 12</td></tr>
<tr><td colspan="5">Key Unit Competence: Think critically to understand and perform operations on the set of real numbers</td></tr>
<tr><td colspan="3">Learning Objectives</td><td rowspan="2">Content</td><td rowspan="2">Learning Activities</td></tr>
<tr><td>Knowledge and understanding</td><td>Skills</td><td>Attitudes and values</td></tr>
<tr><td>• Match a number and the set to which it belongs.
• Define a power, an exponential, a radical, a logarithm and the absolute valueof a real number.</td><td>• Classify numbers into naturals, integers, rational and irrationals.
• Perform numerical calculations in the set $\mathbb{R}$ of real numbers.
• Determine the restrictions on the variables in rational and irrational expressions.</td><td>• Appreciate the importance and the use of properties of operations on real numbers
• Show curiosityfor the study of operations on real numbers.</td><td>• Set of Real numbers.
– Elements of the set $\mathbb{R}$ of real numbers.
– Operations on the set of real numbers.
– Arithmetic of integers and whole numbers.
– Rounding and estimating decimal numbers.
– Equivalent fractions, ratios and proportions, rates.</td><td>• Group investigation
-- Make research in advance in the library about Sets of numbers (natural numbers, integers, rational numbers and irrational numbers).
– Use a thermometer to explore the use of positive and negative integers in medicine.</td></tr>
</table>

	• Illustrate each propertyof a power, an exponential, a radical, alogarithm, the absolute value of a real number • Use logarithm and exponentials to model simple problems about population growth, decay, compound interest, magnitude of an earthquake... • Transform a logarithmic expression to equivalent power or radical form and vice versa. • Rewrite an expression containing "absolute value" using order relation/ inequality signs.		• Absolute value and its properties. • Powers andradicals. • Decimal logarithmsand properties.	• Perform simple clinical calculations related to operations on whole numbers, fractions, and ratios.
***Links to other subjects**: Physics, e.g. converting temperature from degree Celsius to degree Fahrenheit, converting seconds to minutes and vice versa Entrepreneurship, Chemistry: e.g. The decay process Biology: e.g. growth of bacteria.*				
***Assessment criteria**: Ability to think critically to understand and perform operations on the set of real numbers*				
***Materials**: Graph papers, manila papers, digital technology including calculators,...*				

Topic Area: TRIGONOMETRY		Sub-topic Area: TRIGONOMETRIC CIRCLE AND IDENTITIES		
S4- MATHEMATICS	**Unit 2:** Fundamentals of trigonometry			**Number of Periods: 15**
Key unit Competence: Use the trigonometric concepts and formulas to solve related problems in Physics, Air navigation, Water navigation, bearings, Surveying, and modern medicine.				
Learning Objectives			**Contents**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
• Define sine, cosine, and tangent (cosecant, secant, and cotangent) ofany angle special angles (30°, 45°, 60°). • Convert radians to degree and vice versa. • Differentiate between complementary angles, supplementary angles and co-terminal angles.	• Represent graphically sine, cosine and tangent, functions and, together with the unit circle, • Use trigonometry, including the sine and cosine rules, to solve problems involving triangles.	• Appreciate the relationship between the trigonometric values for different angles.	• Trigonometric concepts: – Angle and its measurements. – Unit circle. – Trigonometric ratios. – Trigonometric identities. • Application of trigonometry in: – Bearing – Air Navigation – Inclined plane. – Cardiology.	• Mental task – imagine a point on the edge of a wheel – as the wheel turns, how high is the point above the center? – sketch the graph. • Practical – on graph paper draw a circle of radius 10cm and measure half chord length and distance from center to chord for angles (say multiples of 15^{o}) – plot the cartesian plane – use calculator to determine the sine and cosine of this angle.What is the radius of the circle?

				• Use of dynamic geometry (such as geogebra) and graphplotting to illustrate relationship between sine, cosine, and sides of the triangle. • In groups use unit circle and graphs to determine the relationship between trigonometric values of any angle. • Group investigation -What angle subtends an arc length equal to the radius? What is a radian? Make a table of equivalences between radians and degrees. • Derive trigonometric identities, sine and cosine rules. • Apply trigonometry to solve practical problems involving triangles and angles.
Links to other subjects: *Physics (optics, wave, electricity), medicine (cardiology).*				
Assessment criteria: *Ability to 4se the trigonometric concepts and formulas to solve related problems in Physics, Air navigation, Water navigation, bearings, Surveying,* and modern medicine.				
Materials: *Geometric instruments (ruler, T-square, compass), graph papers, digital technology including calculators, thermometers, etc.*				

<table>
<tr><td colspan="2">Topic Area: ALGEBRA</td><td colspan="3">Sub-topic Area: EQUATIONS AND INEQUALITIES</td></tr>
<tr><td>S4 - MATHEMATICS</td><td colspan="2">Unit 3: Linear, Quadratic equations and inequalities</td><td colspan="2">Number of Periods: 12</td></tr>
<tr><td colspan="5">Key unit Competence: Model and solve algebraically or graphically daily life problems involving linear, quadratic equations or inequalities.</td></tr>
<tr><td colspan="3">Learning Objectives</td><td rowspan="2">Content</td><td rowspan="2">Learning Activities</td></tr>
<tr><td>Knowledge and understanding</td><td>Skills</td><td>Attitudes and values</td></tr>
<tr><td>• List the steps to follow in solving a word problem involving linear or quadratic equations or inequalities.</td><td>• Solve graphically and algebraically a word problem involving linear or quadratic equations or inequalities .</td><td>• Appreciate the importance of linear equations and inequalities in solving related word problems from a given situation.
• Listen Colleagues' arguments in solving linear or quadratic equations or inequalities</td><td>• Equations and inequalities inone unknown.
• Simultaneous equations in twounknowns.
• Quadratic equations in one unknown.
• Applications:
– Economics (Problems about supply and demand analysis, …)
– Physics (Linear motions,Electric circuits, projectile motions, …)
– Chemistry (Balancingequations…)
– Medicine (medication dose calculation).</td><td>• Group investigation - discuss in groups the importance and necessity of linear equations and inequalities and how it takes place in medicine. Practical - solve graphically and algebraically linear equations and simultaneous equations.</td></tr>
<tr><td colspan="5">Links to other subjects: Physics (kinematics), Chemistry, Medicine, etc.</td></tr>
<tr><td colspan="5">Assessment criteria: Ability to model and solve algebraically or graphically daily life problems using linear or quadratic equations or inequalities.</td></tr>
<tr><td colspan="5">Materials: Geometric instruments (ruler-square ....), Digital technology including calculators.</td></tr>
</table>

Topic Area: ANALYSIS			**Sub-topic Area: FUNCTIONS**	
S4-MATHEMATICS	**Unit 4**: Polynomial, Rational and Irrational functions		**Number of Periods: 12**	
Key unit Competence: Use concepts and definitions of Polynomial, Rational and Irrational functions to determine their domain represent and interpret their graphs.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
• Identify a functionas a rule and recognize rules that are not functions. • Determine the domain and rangeof a function. • Construct composition of functions • Find the even andodd parts of a function.	• Perform operations on functions • Apply different properties of functions to model and solve related problems in various practical contexts. • Analyse, model andsolve problems involving linear or quadratic functions and interpret the results.	• Increase self-confidenceand 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. • Show concern on patience, mutual respect and tolerance.	• Generalities on numerical functions: – **Definition.** – **Types of functions (Polynomial, rational, irrational functions)** – **Injective, surjective and bijective functions,** – Existence conditions for a given function. • Domain of definition and range of a numerical function (Polynomial functions, rational functions, irrational functions).	• Study algebraically andgraphically polynomial functions. • Practical: discuss in groups, different techniques of factorization of polynomials. • Model or interpret the problems related to polynomial functions.

Demonstrate an understanding of operations on, and compositions of functions.			• Parity of a function(odd or even). • Factorization and expansion of polynomials. • Graphical interpretation of linear, quadratic, polynomial, and simple rational functions. • Application of polynomial functions in Physics, chemistry and medicine.	
Links to other subjects: *Physics (eg: Use a quadratic function to model the fall of a ball, Chemistry (use polynomial to express the rate of reaction in chemistry)*				
Assessment criteria: Use concepts and definitions of Polynomial, Rational and Irrational functions to determine their domain, represent and interpret their graphs.				
Materials: *Pair of compasses, Graph Papers, ruler, Digital technology (including calculators,…)*				

Topic Area: ANALYSIS Sub-topic Area: LIMITS, DIFFERENTIATION AND INTEGRATION				
S4 - MATHEMATICS	**Unit 5:** Limits of polynomial, rational and irrational functions			**Number of Periods: 9**
Key unit Competence: Evaluate correctly limits of functions and apply them to solve related problems				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
• Define the conceptof limit for real- valued functions ofone real variable • Evaluate the limit of a function and extend this concept to determine the asymptotes of the given function.	• Calculate limits of certain elementary functions • Solve problems involving continuity. • Apply informal methods to explore the concept of a limit including one sidedlimits. • Use the concepts of limits to calculate the asymptotes tothe rational and polynomial Functions	• Appreciate the importance, uæand determination of limit of functions in solving problems.	• Concepts of limits: – Neighborhood of a real number – Limit of a variable – Definition and graphical interpretation of limit of a function – One-sided limits – Squeeze theorem – Limits of functions atinfinity. – Operations on limits • Indeterminate cases: , , , -, 0,	• Discuss in group how to evaluate the limit of a function at a point both algebraically and graphically, extend this understanding to determine the asymptotes. • Represent on graph papers limits of some chosen functions and draw the possible asymptotes

			• Applications of limits: – Continuity of a function at a point oron interval I. – Asymptotes	
Links to other subjects: *Physics (Calculation of velocity, acceleration using concepts of limits)*				
Assessment criteria: *Ability to evaluate correctly limits of functions and apply them to solve related problems*				
Materials: *Manila papers, Graph Papers, ruler, markers ,Digital technology,…*				

Topic Area: ANALYSIS Sub-Topic Area: LIMITS. DIFFERENTIATION AND INTEGRATION		
S4 - MATHEMATICS	**Unit 6:** Differentiation of polynomials, rational andirrational functions and their applications	Number of Periods:9
Key unit Competence: Use differentiation to solve and interpret problems in various contexts.		

Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
• Define and evaluate from first principles the gradient at apoint. • Identify techniques (rules) of differentiation to any differentiable function.	• Evaluate derivatives of functions using the definition of derivative. • Perform operations on derivative of rational functions and simple trigonometric functions (sine, cosine, tangent and cotangent). • Use first principles to determine the gradient of a straight line at a point.	• Appreciate the use of gradient as a measureof rate of change. • Appreciate the importance and use of differentiation in Kinematics (velocity, acceleration).	• Concepts of derivativeof a function: – Definition – High orderderivatives. • Rules of differentiation • Applications of differentiation: – Geometric interpretation ofderivatives: – Equation of the tangent to acurve. – Equation of normal to acurve.	• Group investigation Determine the gradient of different functions at a point using definition of derivatives, from first principles, chain rule, and interpret the results. • Practical - represent on graphpapers the gradient of a straight line and interpret it geometrically in various practical problems.

	• Use the derivative to find the equation of a line tangent or normalto a curve at a given point. • Apply the concepts and techniques of differentiation to model, analyze and solve rates problems in different situation.		• Hospital's theorem • Variations offunctions. • Ratesproblems.	• In group, use different techniques of differentiation to model, to analyzeand solve rates problems. • In group, determine rate ofchange from practical various problems and interpret the results.
Links to other subjects: *Physics, Economics (in Optimization problems , related rates problems, …)*				
Assessment criteria: Ability to use differentiation to solve and interpret problems in various contexts.				
Materials: *Manila paper, graph paper, digital technology including calculators ...*				

<table>
<tr><td colspan="3">Topic Area: LINEAR ALGEBRA</td><td colspan="2">Sub-topic Area: VECTORS</td></tr>
<tr><td colspan="2">S4 – MATHEMATICS</td><td>**Unit 7:** Vector Space of real numbers</td><td colspan="2">**Number of Periods: 6**</td></tr>
<tr><td colspan="5">**Key unit Competence**: Use concepts of vectors in 2D to solve related problems such as distance, angles,…</td></tr>
<tr><td colspan="3">Learning Objectives</td><td rowspan="2">Content</td><td rowspan="2">Learning Activities</td></tr>
<tr><td>Knowledge and understanding</td><td>Skills</td><td>Attitudes andvalues</td></tr>
<tr><td>• Define the scalarproduct of two vectors.
• Give examples ofscalar product
• Determine the magnitude of vector and anglebetween two vectors.</td><td>• Calculate the scalar product oftwo vectors.
• Analyse a vectorin term of size.
• Determine theangle betweentwo vectors
• Use concepts of vectors in 2D to solve related problems</td><td>• Appreciate the importance of vectors in solving daily life problems that involve vectors.</td><td>• Euclidian Vector space
– Concept of vector in 2D.
– Operation and properties of vectors in 2D.
– Dot product and properties.
– Modulus or Magnitude ofvectors.
– Angle between two vectors.</td><td>• In group, make research on vectors in 2D, Operations of vectors and their properties.
• Group investigation:
– Discuss about the scalar product of two vectors,
– Determine the magnitude of vector and measure the angle between two vectors.</td></tr>
<tr><td colspan="5">***Links to other subjects:*** *Physics (Dynamics).*</td></tr>
<tr><td colspan="5">***Assessment criteria:*** *Ability to use concepts of vectors in 2D to solve related problems such as distance, angles,…*</td></tr>
<tr><td colspan="5">***Materials****: Manila papers, Graph papers, Geometric instruments : rulers , T-square ,Protectors, Computers ...*</td></tr>
</table>

Topic Area: LINEAR ALGEBRA		Sub-Topic Area: LINEAR TRANSFORMATION IN 2D		
S4 – MATHEMATICS		**Unit 8:** Matrices of and determinants of order 2		Number of Periods: 9
Key Unit Competence: Use matrices and determinants of order 2 to solve problems involving the system of 2 linear equations with 2 unknowns.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
• Define the order of a matrix. • Define a linear transformationin 2D by a matrix. • Define operations on matrices of order 2. • Show that a square matrix oforder 2 is invertible or not.	• Reorganize datainto matrices. • Perform operationson matrices of order 2. • Determine the inverse of a matrixof order 2. • Use matrices to solve problems such as organization of data in shopping, medicine, or in Physics (problems about quantum orcircuits).	• Appreciate the importance and the use of matrices in organizing data. • Show curiosity for the use and application of matrix concepts in solving problems.	• Operations onmatrices: – Equality ofmatrices. – Addition of matrices. – Multiplication of a matrix by a scalar. – Multiplication of matrices. – Transpose of a matrix. – Inverse of a square matrix. • Determinant of amatrix of order 2.	In group: • Reorganize given data into matrices and then perform different operations on matricesincluding the calculation of their determinants. • In group discuss how to prove that a matrix of order 2 is invertible.

			• Applications of matrices in solving daily life problems (physics, buying and selling, medicine).	• Individually make research about the importance and the use of matrices in solving daily life problems (physics, buying and selling, medicine) and report the findings.
Links to other subjects: *Physics (problems about quantum or circuits), medicine*				
Assessment criteria: Ability to use matrices and determinants of order 2 to solve problems involving the system of 2 linear equations with 2 unknowns.				
Materials: *Geometric instruments (ruler, T-square, pair of compasses), graph papers, digital technology including calculators,…*				

Topic Area: STATISTICS AND PROBABILITY		Sub-topic Area: DESCRIPTIVE STATISTICS		
S4 – MATHEMATICS		**Unit 9:** Measures of dispersion		Number of Periods: 6
Key Topic Competence: Extend understanding, analysis and interpretation of data arising from problems in daily life to the standard deviation.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes andvalues		
• Define the variance, standard deviation and the coefficient of variation. • Analyze and critically interpret data and infer conclusion.	• Determine the measures of dispersion of a given statisticalseries. • Apply and explainthe standard deviation as the more convenient measure of the variability in the interpretation of data. • Express the coefficient of variation as a measure of the spread of a set ofdata as a proportion of itsmean.	• Appreciate the importance of measures of dispersion in the interpretation of data. • Show concern on how to usethe standard deviation as measure of variability of data.	• Variance. • Standard deviation (including combined setof data). • Coefficient of variation. • Application of measures of dispersion in nursing and medicine: – Problems to include measure of dispersion and explain the standard deviation as the more convenient measure of the variability in the interpretation of data.	In group, Discuss the measures of dispersion, interpretthem, and represent the findings. • Represent data on graph papers, interpret them and infer conclusion. • Make research on given problems arising fromvarious situations in nursing or medicine, investigate them, determine the standard deviation and represent the findings.

			– Problems to include measure of dispersion and express the coefficient of variation as a measure of the spread of a set of data as a proportion of its mean.	
Links to other subjects: *Physics, Biology, Chemistry and medicine.*				
Assessment criteria: *Ability to extend understanding, analysis and interpretation of data arising from problems in daily life to the standard deviation.*				
Materials: *Manila papers, Graph Papers, ruler, digital technology including calculators, etc.*				

Topic Area: STATISTICS AND PROBABILITY		Sub-topic Area: COMBINATORIAL ANALYSIS AND PROBABILITY		
S4 – MATHEMATICS		**Unit 10:** Elementary probability		Number of Periods: 18
Key unit Competence: Use combinations and permutations to determine the number of outcomes and the probability for an event.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
• Define the combinatorial analysis. • Define factorial and recognize that for n different items there are different combinations. • Construct Pascal's triangle. • Distinguish between permutations and combinations. • Define notion, axioms of probability and explain probability as a measure of chance.	• Determine the number of permutations and combinations of"n" items, "r" taken at a time. • Use counting techniques tosolve related problems. • Use and apply properties of probability to calculate the number possible outcomes of occurring event under equally likely	• Appreciate the importance and the use of counting techniques. • Appreciate the use of probability as a measure of chance. • Show concern on patience, mutual respect, tolerance and the curiosity of finding the possible outcomes of occurring event under equally likely assumptions.	• Counting techniques: – Venn diagram – Tree diagrams – Contingency table – Multiplication principles. • Arrangement and Permutations. • Combinations: – Definitions and properties – Pascal's triangles – Binomial expansion	• Mental task: Imagine you are a photographer sitting agroup in a row for pictures. You need to determine how many different ways you can seat the group. • Solve in in group questions aboutcounting techniques for example "In how many different ways could a committee of 5people be chosen froma class of 30 students?"

Distinguish between mutually exclusive and non-exclusive events and compute theirprobabilities. • Compute expectations and determine the probability of events arising from an experiment with a • number of possible outcomes.	Assumptions. • Determine and explain expectations from an experiment with possible outcomes		• Concepts ofprobability: – Random experiment – Sample space – Event – Definition of probability of an event under equally likely assumptions. • Properties of probability. • Basic rules of probability and formulas. • Examples of events in medicine and determination of related probability.	Form theirproper words using letters of "MISSISSIPI",without prior instructions, then givefeedback. • Sit 3 men and 4women at random in a row. In groups, discuss the probability that either all are men or all the women end up sitting together, and then give feedback.
Links to other subjects: *English, Physics, Biology, Chemistry, , Medical sciences…*				
Assessment criteria: *Ability to use combinations and permutations to determine the number of outcomes and the probability for an event*				
Materials: *Manila papers, Graph Papers, ruler, digital components including calculators …*				

3.3. Secondary Five

3.3.1. Key Competences at the end of Secondary Five

After completion of secondary 5, the mathematics syllabus will help the learner to:

- Solve trigonometric equations and related real-life problems.
- Use arithmetic, geometric and harmonic sequences and their convergence to understand and solve problems arising in various context.
- Solve equations involving logarithms or exponentials and apply them to model and solve related problems.
- Apply theorems of limits and formulas of derivatives to solve problems involving trigonometric functions.
- Extend the use of matrices and determinants of order 3 to solve problems in various contexts.
- Apply properties of vectors and their operations in to solve problems related to angles between vectors.
- Extend the understanding, analysis and interpretation of bivariate data to correlation coefficients and regression lines.
- Apply Bayes theorem in solving problems involving the conditional probability.

3.3.2. Mathematics units for Secondary Five

<table>
<tr><td colspan="5">Topic Area: TRIGONOMETRY Sub-topic Area: TRIGONOMETRIC FUNCTIONS AND EQUATIONS</td></tr>
<tr><td colspan="2">S5 – MATHEMATICS</td><td colspan="2">Unit 1: Trigonometric equations</td><td>Number of Periods: 15</td></tr>
<tr><td colspan="5">Key unit Competence: Solve trigonometric equations and related real-life problems.</td></tr>
<tr><td colspan="3">Learning Objectives</td><td rowspan="2">Contents</td><td rowspan="2">Learning Activities</td></tr>
<tr><td>Knowledge and understanding</td><td>Skills</td><td>Attitudes and values</td></tr>
<tr><td>• Show how to use transformation formula to simplify the trigonometric expressions.
• Define a trigonometric equation.
• List the steps for solving a trigonometric equation.</td><td>• Apply the transformation formulas to simplify trigonometric expressions.
• Use the concepts of trigonometric functions and their properties to deduce trigonometric equations.
• Analyze and discuss the solution of trigonometric inequalities.</td><td>• Appreciate the relationship between trigonometry and other subjects.
• Show concern on patience, mutual respect, tolerance and curiosity in the solving and discussion about problems involving trigonometric functions and equations.</td><td>• Transformation formulas:
– Addition and subtraction formulas.
– Double-angle and half-angle formulas.
– Sum, Difference and Product Formulas.
• Trigonometric equations.</td><td>• In groups, discuss on how to simplify trigonometric expressions using transformation formulas.
• Solve problems involving trigonometric equations</td></tr>
</table>

	• Use trigonometric functions and equations to model and solve problems involving trigonometric concepts.		• Application of trigonometric equations in real life and particularly in medicine (cardiology, neurology, and cardiology).	
Links to other subjects: *Physics*				
Assessment criteria: *Ability to solve trigonometric equations and related real-life problems.*				
Materials: *Geometric instruments (Ruler, T-square, compass), graph papers, calculators,…*				

Topic Area: ALGEBRA			Sub-topic Area: NUMBER PATTERNS	
S5 - MATHEMATICS	**Unit 2:** Sequences			Number of Periods: 12
Key unit Competence: Use arithmetic, geometric and harmonic sequences and their convergence to understand and solve problems arising in various context.				
Learning Objectives			Contents	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
• Define a sequence and understand arithmetic progressions andtheir properties. • Determine the value of "n", giventhe sum of the first"n" terms of arithmetic progressions. • Show how to apply formulas to determine the "n^{th}" term and the sum of the first "n" terms of arithmetic progressions. • Define and Explain geometricprogressions andtheir properties.	• Use basic concepts and formulas of sequences to find the value "n", giventhe sum of the first "n" terms of arithmetic progressions - the "n^{th}" term and the sum of the first "n" terms of arithmetic progressions. • Use basic concepts and formulas of sequences to find the value "n", given the sum of thefirst "n" terms of arithmetic progressions - the "n^{th}" term and the sum of the first "n" terms of geometric progressions.	• Appreciate use of sequences in other subjects tounderstand occurring situations (in entrepreneurship and economics: Value of annuity, future value of money …). • Show concern on, patience, mutual respect,tolerance, and curiosity to discuss about sequences and their applications.	• Arithmetic sequences. • Geometric sequences. • Applications of sequences: – Problems including population growth. – Problems including compound and simple interests. – Half-life and Decay problems in Radioactivity.	• 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: 

• Determine the value of "n", giventhe sum of the first"n" terms of geometric progressions. • Show how to apply formulas todetermine specific terms, the"n^{th}" term and thesum of the first "n" terms of geometric progressions.	• Apply the concepts of sequences to solve problems involving arithmeticand geometric sequences.		– Bacteria growth problems in Biology, etc.	…., – Group investigation: If the bank rates increase or decrease unexpectedly, discuss or investigate how will be the situation in the next n- years.
Links to other subjects: *Medicine in Population genetics Problems, Chemistry in Half-life and Decay…*				
Assessment criteria: *Ability to apply concepts of sequences to solve problems involving arithmetic and geometric sequences.*				
Materials: *Geometric instruments (ruler, T-square, compass), graph papers, digital technology including calculators, manila Paper.*				

Topic Area: ALGEBRA		Sub-topic Area: EQUATIONS AND INEQUALITIES		
S5 - MATHEMATICS		**Unit 3:** Logarithmic and exponential equations		Number of Periods:15
Key unit Competence: Solve equations involving logarithms or exponentials and apply them to model and solve relatedproblems.				
Learning Objectives			Contents	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
• Define logarithm or exponential equations using properties of logarithms in anybase. • State and demonstrate properties of logarithms and exponentials.	• Explain the properties of logarithms inany base. • Solve logarithmic andexponential equations. • Convert the logarithm to exponential form. • Apply logarithmsor exponential tosolve rates problems, mortgage problems, population growth problems.	• Appreciate the use of logarithmic equations to modeland solve problem involving logarithms such radioactive-decay problems, Carbon dating problems, problems about alcohol and risk of car accident, etc. • Show concern on patience, mutual respect and tolerance in solvingproblems involving logarithmic orexponential equations.	• Logarithmic equations, including natural logarithms. • Exponential equations. • Application of logarithm and exponentials in solving: – Interest rates problems. – Mortgage problems. – Population growth problems. – Radioactive decay problems. – Earthquakeproblems.	In group or individually,: • Once there is the shape of a logarithmic graph, shift it vertically or horizontally, stretch it, shrink it, reflect it and interpret the graph. • Given for example a growth or decay situation, after investigatingthe situation, write an exponential function and evaluate it for given inputs.

• Carry out operations using the change of baseof logarithms.			– Carbon dating problems. • Problems about alcohol and risk ofcar accident.	
Links to other subjects: *Demography (Population growth Problems), Economics (Interest rates problems, annuity value of* money), etc.				
Assessment criteria: *Ability to apply concepts of logarithmic and exponential equations to solve correctly problems involving logarithms or exponentials.*				
Materials: *Geometric instruments (ruler, T-square, compass), graph papers, digital technology including calculators, Manila* paper…				

Topic Area: ANALYSIS	Sub-topic Area: LIMITS, DIFFERENTIATION, AND INTEGRATION	
S5 - MATHEMATICS	**Unit 4:** Trigonometric and inverse trigonometric functions.	Number of Periods: 12

Key unit Competence: Apply theorems of limits and formulas of derivatives to solve problems involving trigonometric functions.

Learning Objectives			Contents	Learning Activities
Knowledge and understanding	Skills	Attitudes andvalues		
• Use the concepts of function, domain, range, period, inverse function, and limits to define the derivative of trigonometric functions. • List the steps to follow when solving problems involving the limits or derivative of trigonometric or inverse trigonometric functions.	• Apply concepts and definition of limits, to calculate the limits of trigonometric functions and remove their indeterminate forms • Calculate the high derivatives. • Derive techniques of differentiation to model and solve problems related to trigonometry.	• Appreciate the use of limits and derivatives of trigonometric functions to solve problems related to the periodic motion of bodies.	• Trigonometric functions • Generalities: – Definition of trigonometric functions. – Domain andrange of a trigonometric function. – Parity of a function (odd oreven). – Periodic functions. – Limits of trigonometric functions including indeterminate cases: , $0.\infty$.	• In groups, – Plot the graph of trigonometric function of the form: $y = \sin x$ or $y = a \sin bx$ and investigate them. Discuss its period, find its domain of definition and range. – Generalize these activities to other trigonometric functions.

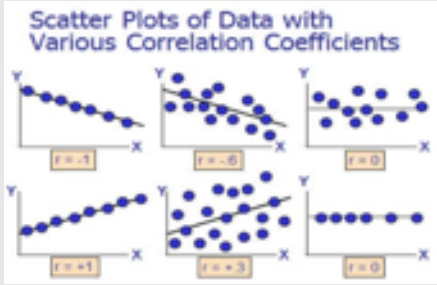
	• Apply techniques of differentiation to solve problems involving trigonometric functions.		• Differentiation of trigonometric functions: – First derivative. – high derivatives. • Application of trigonometric functions in the periodic motion and medicine.	– Calculate high derivatives of these trigonometric functions. • Carry out research on techniques of differentiation of- trigonometric functions and apply them to explain related problems observed in medicine.
Links to other subjects: *Physics (periodic motion), Medicine.*				
Assessment criteria: *Ability to apply theorems of limits and formulas of derivatives to solve problems involving trigonometric functions.*				
Materials: *Geometric instruments (ruler, T-square, compass), graph papers, digital technology including calculators*				

Topic Area: LINEAR ALGEBRA			Sub-topic Area: VECTORS IN 3D	
S5 – MATHEMATICS	**Unit 5:** Vector space of real numbers			Number of Periods: 9
Key unit Competence: Apply properties of vectors and their operations in to solve problems related to angles between vectors.				
Learning Objectives			Contents	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
• Define the dot product and the crossproduct of two vectors in a three-dimensional vector space and list their properties. • Define the magnitudeof a three- dimensional vector and list its properties. • Distinguish between the dot product and the cross product.	• Determine the dot product and the vector product of two vectors in a three-dimensional space and use themto solve practical related problems. • Explain geometrically the dot product and thecross product.	• Appreciate the usefulness of vectors of in the description of quantities such as force,velocity of a body in space.	• Euclidian Vectorspace : – Vector of and examples (e.g: gravitational force). – Operations of vectors of (addition, subtraction, scalar multiplication). – Dot product – and properties. – Modulus or Magnitude ofvectors. – Distance between two points of . – Angle between two vectors. – Vector product and properties.	Perform specific tasks in group, patiently, in mutual respect and tolerance: • Draw a three- dimensional coordinate system and plot some chosen points and represent the corresponding vectors. • Choose some objects to simulate points and vectors in three- dimensional space and ask the audience to describe vectors and related operations. • Study vectors in three-dimensionalcoordinate system to describe quantities such as force, velocity,acceleration, etc.
Links to other subjects: *Physics (force, velocity, acceleration), …*				
Assessment criteria: *Ability to correctly apply properties of vectors and their operations in to solve problems related to angles between vectors.*				
Materials: *Geometric instruments (ruler, T-square, compass), graph papers, digital technology including calculators*				

Topic Area: LINEAR ALGEBRA		Sub-topic Area: LINEAR TRANSFORMATION IN 3D		
S5 – MATHEMATICS		**Unit 6:** Matrices and determinants of order 3		**Number of Periods: 18**
Key unit Competence: Apply matrix and determinant of order 3 to solve related problems.				
Learning Objectives			Contents	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
• Define operationson matrices of order 3. • Illustrate the properties of determinants of matrices of order 3. • Show that a square matrix of order 3 is invertible or not. • Discuss with respect to a parameter the solutions of a system of three linear equations inthree unknowns.	• Perform operations on matrices of order 3. • Calculate the determinants of matrices of order 3. • Explain using determinant whether a matrix of order 3is invertible or not. • Determine the inverse of a matrix of order 3. • Reorganise data into matrices. • Apply matrices to solve related problems (e.g in physics, medicine, or in buying and selling.)	• Appreciate the importance of matrices of order 3 and their determinants in organizing data andsolving related problems.	• Matrix of order 3: definition and examples. • Operations on matrices of order 3: – Equality of matrices. – Addition. – Multiplication by ascalar. – Multiplication of matrices. – Transpose of a matrix. – Inverse of a squarematrix	• Discuss ingroup patiently, in mutual respect and tolerance, how to organize data into matrices of order 3 and apply these concepts to solve related problems. • Discuss in group, the solutions of a system of three linear equations in three unknowns with respect to a parameter.

	• Use Cramer's rule to solve a system of three linear equations in three unknowns. • Apply properties of determinants to solve problems related to matricesof order 3.		• Determinant of a matrixof order 3: Definition and examples. • Applications of determinants in solving problems from physics, medicine, or buying and selling.	
Links to other subjects: *Physics (Expressing force, velocity, acceleration).*				
Assessment criteria: *Ability to apply matrix and determinant of order 3 to solve related problems successively.*				
Materials: *Graph papers, digital technology including calculators.*				

Topic Area: STATISTICS AND PROBABILITY		Sub-topic Area: DESCRIPTIVE STATISTICS		
S5 – MATHEMATICS			**Unit 7:** Bivariate statistics	Number of Periods: 12
Key unit Competence: Extend understanding, analysis, and interpretation of bivariate data to correlation coefficients and regression lines.				
Learning Objectives			Contents	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
• Define the covariance, coefficient of correlation and regression lines. • List the steps for analyzing and interpreting data critically to infer conclusion.	• Determine the coefficient of correlation, covariance, and regression lines of bivariate statistical data. • Apply and explain the coefficient of correlation and standard deviation as the more convenient measure of the variabilityin the interpretation of data.	• Appreciate the importance of regression lines and coefficient of correlation when analyzing, interpreting, and inferring conclusion on statistical data.	• Recall on bivariate data. • Covariance. • Correlation coefficient of bivariate data. • Regression lines. • Applications: – Data analysis, interpretation and prediction problems in various areas (Biology, Business, medicine and Demography).	• Discuss, in groups, the correlation between class results and students' ranks in the class. investigate them, analyze the relationship between them, and check how the coefficient of correlation reflects the amount of variability that is shared between data them and what they have in common. Then, infer conclusion. • Plot data on scatter diagram or scatter plot to represent a correlation between two variables.

		• Analyze and interpret data critically and infer conclusion.		Analyze the graph and infer conclusion using coefficient of correlation to make predictions about the variables studied. E.g 
Links to other subjects: *Geography (spatial statistics research, Air pollution in different year…), Biology (Bio-statistics, ….),* Chemistry, Demography (Population growth,…),…				
Assessment criteria: *Ability to correctly* 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*				

<table>
<tr><td colspan="5">Topic Area: STATISTICS AND PROBABILITY Sub-topic Area: PROBABILITY</td></tr>
<tr><td colspan="2">S5 – MATHEMATICS</td><td colspan="2">Unit 8: Conditional probability and Bayes theorem</td><td>Number of Periods: 15</td></tr>
<tr><td colspan="5">Key unit Competence: Apply Bayes theorem in solving real life problems involving the conditional probability.</td></tr>
<tr><td colspan="3">Learning Objectives</td><td rowspan="2">Contents</td><td rowspan="2">Learning Activities</td></tr>
<tr><td>Knowledge and understanding</td><td>Skills</td><td>Attitudes and values</td></tr>
<tr><td>• Explain the conditional probability</td><td>• Apply theorem of probability tocalculate the number possible outcomes of occurring independent events under equally likely assumptions.
• Compute the probability of an event B occurring when event A hasalready taken place.
• Apply Bayes theorem to solve problems involving conditional probability.</td><td>• Appreciate the use of conditional probability in solving some problems.</td><td>• Independent and dependent events.
• Conditional probability:
– Probability of event B occurring when event A has already taken place.
– Basic formulae andproperties of conditional Probability.
– Bayes theorem and itsapplications.</td><td>• Discuss in groups about number of possible outcomes of event B occurring when evenA has already taken place.
• In a given task, use Bayes theorem to determine the probability of event B occurring when event A has already taken place.</td></tr>
<tr><td colspan="5">Links to other subjects: Biology, Chemistry. …</td></tr>
<tr><td colspan="5">Assessment criteria: Ability to apply Bayes theorem in solving real life problems involving the conditional probability.</td></tr>
<tr><td colspan="5">Materials: Manila papers, ,markers, digital technology including calculators</td></tr>
</table>

3.4. Secondary Six

3.4.1. Key competences at the end of Secondary Six

After completion of secondary 6, the mathematics syllabus will help the learner to:

- Perform operations on complex numbers and solve related problems in physics, …
- Extend the use of concepts and definitions of functions to determine the domain of logarithmic and exponential functions.
- Use integrations as the inverse of differentiation and as the limit of a sum and apply them to find area of plane shapes.
- Use ordinary differential equations of first and second order to solve related problems that arise in a variety of practical contexts.

3.4.2. Mathematics Units for Secondary Six

<table>
<tr><td colspan="3">Topic Area: ALGEBRA</td><td colspan="2">Sub-topic Area: NUMBERS AND OPERATIONS</td></tr>
<tr><td colspan="2">S6 – MATHEMATICS</td><td>Unit 1: COMPLEX NUMBERS</td><td colspan="2">Number of Periods: 27</td></tr>
<tr><td colspan="5">Key unit competence: Perform operations on complex numbers and solve related problems in physics, …</td></tr>
<tr><td colspan="3">Learning Objectives</td><td rowspan="2">Content</td><td rowspan="2">Learning Activities</td></tr>
<tr><td>Knowledge and understanding</td><td>Skills</td><td>Attitudes and values</td></tr>
<tr><td>• Identify the real part and the imaginary part of a complex number</td><td>• Apply the properties of complex numbers to perform operations on complex numbers in algebraic form, in polar form orin exponential form</td><td>• Appreciate the importance of complex numbers to solve related problems in Physics (voltage and current in alternating current), Computer Science (fractals),</td><td>• Algebraic form of Complex numbers
• Definition and properties of “ i ”
• Operations:
– Addition, subtraction, multiplication,powers, Conjugate anddivision</td><td>• Mental work; Use definition of the multiplication of complex numbers to determine the complex number whose square is -1 and draw conclusion about the properties of “i”</td></tr>
</table>

• Convert a complex number from one form to another • Represent acomplex number on Argand diagram. • State De Moivre's formula and Euler's formula.	• Find the modulus and the square rootsof a complex number Solve in the setof complex numbers a linear or quadratic equation • Apply De Moivre's formula and Euler's formulato transform trigonometric expressions.	Trigonometry (Euler's formula to transform trigonometric expressions), …	• Modulus of a complex number • Square roots in theset "C" of complexnumbers Equations in the set **C** of complexnumbers • Geometric representation of complex numbers • Polar form of complex numbers – Definition – Modulus and argument of a complex number – Operations – De Moivre's formula • Exponential forms of complex numbers: – Definition and operations • Euler's formulaof complex numbers.	• Derive properties of operations on complex numbersin trigonometric form and apply complex numbersto transform trigonometric formulas Use internet to determine the generation of fractals by complex numbers and print the different shapes to present in class.
Links to other subjects: *Physics (alternating current), Computer science(fractals)* ***,...***				
Assessment criteria: *Ability to perform operations on complex numbers and solve related problems in physics, …*				
Materials: *Geometric instruments (ruler, T-square, compass), IT equipments, ...*				

Topic Area: ANALYSIS		Sub-topic Area: LIMITS, DIFFERENTIATION and INTEGRATION		
S6-MATHEMATICS	**Unit 2:** LOGARITHMIC AND EXPONENTIAL FUNCTIONS			Number of Periods: 24
Key unit competence: Extend the use of concepts and definitions of functions to determine the domain of logarithmic and exponential functions.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
• State the restrictions on the base and thevariable in a logarithmic function • Extend the concept of functions to investigate logarithmic and exponential functions • Perform operations on logarithmic and exponential functions in any base	• Transform a logarithm from a base toanother • Find the domain and the range of a logarithmic or an exponentialfunction. • Determine limits of logarithmicand exponentialfunctions. Determine possible asymptotes ofa logarithmic or an exponentialfunction • Determine the derivative of a logarithmic or an exponentialfunction	• Appreciate the importance of logarithmic and exponential functions in solving problems such as carbon datingin Chemistry, … • Develop patience, dedication and commitment in solving problems aboutlogarithmic andexponential functions	• 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	• Use scientificcalculators to evaluate logarithms and exponentials of real numbers; they conclude about the domain (the allowed input values) and the range (the set of possible outputs) • Use software, such as Geogebra, to graph logarithmic and exponential functions and report to class the findings about the general trend of the graphs.

• Recall the differentiation formulas for logarithmic and exponential functions.	• Solve problems involving logarithms.		• Applications of logarithmic and exponential functions: – Interest ratesproblems – Mortgage problems – Population growth problems – Radioactive decay problems – Earthquake problems – Carbon datingproblems – Problems about alcohol and risk of caraccident.	• Derive formulas about differentiation of logarithmic and exponential functions. • Discuss in groups theapplications of logarithms and exponentials in real life and report the results.
Links to other subjects: *Physics (Newton's law of cooling), Economics (Compounded interest), Biology (population growth), Chemistry (carbon dating).*				
Assessment criteria*: Ability to extend the concepts of functions to investigate logarithmic and exponential functions and use them to model and solve problems about interest rates, population growth or decay, magnitude of earthquake, etc*				
Materials: *Graph Papers, ruler, digital technologies including calculators …*				

Topic Area: ANALYSIS		Sub-topic Area: LIMITS, DIFFERENTIATION and INTEGRATION		
S6 - MATHEMATICS		**Unit 3:** INTEGRATION		**No. of Periods: 30**
Key Unit Competence: Use integration as the inverse of differentiation and as the limit of a sum and apply them to find area of a plane shapes.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
• Define the differential of a function • Interpret geometrically the differentialof a function • List the differentiation formulas • State and clarify the relationship between derivative andantiderivativeof a function • Illustrate theuse of basic integration formulas	• Use differentials to approximate a function and to calculate the percentage error in an estimation • Calculate integrals using appropriate techniques. • Use properties of integrals to simplify the calculation of integrals • Calculate a limit of a sumto infinity as a definite integral	• Appreciate the importance of integral calculusin solving problems from daily life.	• Indefinite integrals – Antiderivatives – Definition andproperties – Techniques ofintegration: – Basic Integration Formulas – Integration bychange of variables – Integration byParts • Definite integrals – Definition – Properties – Techniques of integration – Applications of definite integrals	• Graphical approach: Shade the area bounded by a curve, the x-axis, and two vertical lines intersecting x-axis. Considering consecutive sub-intervals on x-axis, calculate theareas of corresponding rectangles, then introduce the concept of integral as sum to infinity when the width tends to zero.

• Extend the concepts of indefinite integrals todefinite integrals.	• Apply definite integrals to calculate the area • Analyze the convergence of an improper integral • Use integralsto solve problems in Physics (work...), Economics (marginal and totalcost),etc.		– Calculation of area of a planesurface	
Links to other subjects: *Physics and chemistry.*				
Assessment criteria: *Ability to use integration as the inverse of differentiation and as the limit of a sum and apply them to find area of a plane shapes.*				
Materials: *Manila papers, Graph Papers, ruler, markers …*				

Topic Area: ANALYSIS		Sub-topic Area: LIMITS, DIFFERENTIATION and INTEGRATION		
S6 - MATHEMATICS		**Unit 4:** ORDINARY DIFFERENTIAL EQUATIONS		No. of Periods: 27
Key unit competence: Use ordinary differential equations of first and second order to model and solve related problems in Physics, Chemistry, Biology and medicine.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
• Extend the concepts of differentiation and integrationto ordinary differential equations • State the orderand the degreeof an ordinary differential equation • Express the auxiliary quadratic equation of a homogeneous linear differential equation of second order with constant coefficients	• Determine whether an ordinary differential equation of firstorder is with separable variables, homogeneous or linear • Use appropriate method to solvean ordinary differential equation of first order • Solve an ordinary linear differential equation of first	• Appreciate the use ofdifferential equationsin solving problems occurring from daily life	• Definition and classification • 1st Order differential equations – Differential equations with separable variables – Linear differential equations – Applications • 2nd Order differential equations – Linear equations with constant coefficients:	• Mental task: imagine themotion of a child on a swing. Express the displacement as function of time. Differentiate the function to find the velocity and acceleration, and then express the relation between the function and its derivatives. Report your results. • Use graph plotting to illustrate the general solution of a differential equation • Discuss in groups the solutions of a differential equation

• Predict the form of the particular solution of an ordinary linear differential equation of second order	order by "variation of constant" and by "integrating factor" • Solve an ordinary linear differential equation of second order. • Use differential equations to model and solve problems in Physics (simple harmonic motion,…),Economics(point elasticity,…),etc.		– The right hand side is equal to zero • Applications: – Physics – Medicine – Chemistry – Crime investigation – Etc.	with respect to a parameter and present the result to the class, show ability to communicate your thinking and reasoning - Use internet to find the applications of differential equations in sciences and report your findings to the class
Links to other subjects: *Physics (simple harmonic motion), Chemistry (radioactive decay), Medicine(population genetics, rate of change), etc.*				
Assessment criteria: *Ability to use ordinary differential equations of first to model and solve related problems tin* Physics, Economics, Chemistry, Biology, …				
Materials: *Geometric instruments, graph papers, calculators, ICT equipments,…*				

4. REFERENCES

1. Alpers, B. (2013). *A Framework for Mathematics Curricula in Engineering Education*: *A Report of the Mathematics Working Group.* European Society for Engineering Education (SEFI): Brussels
2. Balakrishnan, V.K. (1995). *Schaum's Outline, Combinatorics.*
3. Bird, J. (2003). *Engineering Mathematics* (4th Edition).
4. Bronson, R. (2003). Schaum's Outline, Differential equation.
5. CrashwshaW,J.,& Chambers,J.(2001).*Advanced Level Statistics with worked examples* (Fourth Edition). Nelson Thornes Ltd:UK
6. Curriculum Planning and Development Division (2006). *Secondary Mathematics Syllabuses*. Ministry of Education: Singapore
7. Frank Ayres, F., & Moyer,E.R.(1999). *Schaum' s Outline Series Trigonometry* (3rd Edition).
8. National Curriculum Development Centre (2008). Mathematics teaching syllabus: Uganda Certificate of Education Senior1-4. Ministry of Education and Sports: Uganda.
9. National Curriculum Development Centre (2013). *Uganda Advanced Certificate of Education: Teaching Syllabi for Physics and Mathematics* (Volume 2). Ministry of Education and Sports: Uganda.
10. National Curriculum Development Centre (2013). *Uganda Advanced Certificate of Education: Subsidiary Mathematics teaching syllabus*. Ministry of Education and Sports: Uganda.
11. Rich, B. & Thomas, C. (2009). *Schaum's Outline, Geometry: Fourth Edition.*
12. Rwanda Education Board (2010). *Advanced Level Mathematics for Science Combination*. Ministry of Education: Rwanda
13. Rwanda Education Board (2014). *Mathematics Curriculum for Physics - Chemistry - Biology (PCB) Combination(Elective) Advanced Level.* Ministry of Education: Rwanda

14. Sanchez, A.V, & Ruiz, M.P. (2008). *Competence-Based Learning: A proposal for the assessment of Generic Competences(Eds)*.

15. Shampiyona, A. (2005). *Mathématiques 6.* Imprimerie de Kigali: Kigali

16. Spiegel,M. R.; Schiller, J. & Srinivasan, A. (2009). *Schaum's Outline, Probability and Statistics: Third Edition.*

17. Stewart, J. (2008). *Calculus* (6th Edition)

18. Stewart, J. (2008). *Calculus Early Transcendental*, sixth edition. McMaster University: US.

19. Wrede,R., Murray,D., & Spiegel, R. (2010). *Schaum's Outline, Advanced calculus, 3rd Edition*.

5. APPENDIX: SUBJECTS AND WEEKLY TIME ALOCATION FOR ASSOCIATE NURSING PROGRAM

No	Subjects	Weight	WEEKLY TIME ALLOCATION		
			S4	S5	S6
1	Fundamentals of Nursing *	11	7	7	7
2	Biology*	11	7	7	7
3	Chemistry*	11	7	7	7
4	Mathematics*	5	3	3	3
5	Physics*	10	6	6	6
6	Ethics and professional code of conduct	1	1	1	0
7	Medical Pathology	2	0	3	1
8	Surgical Pathology	1	0	1	1
9	Pharmacology	4	3	2	2
10	Maternal and Child health	7	4	4	4
11	Individual learning	5	3	1	5
12	Clinical attachment*	13	6	7	10
13	Kinyarwanda	3	2	2	0
14	English*	6	4	4	4
15	French	2	1	1	1
16	Entrepreneurship	2	2	1	0
17	Citizenship	2	2	1	0
18	ICT	2	1	1	1
19	Sports/ Clubs	2	1	1	1
Total periods / week		**100**	**60**	**60**	**60**
Total number of contact/years			**2340**	**2340**	**2340**
Total number of contact hours/year (39 weeks)			**1560**	**1560**	**1560**