European Schools

Office of the Secretary-General

Pedagogical development Unit

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S4-S7

MATHEMATICS SYLLABUS YEAR 4 to YEAR 7

Preamble

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PREAMBLE

1. OBJECTIVES

1.1. General objectives

The secondary section of the European Schools needs to perform the dual task of providing formal, subject-based education and of encouraging pupils' personal development in a wider social and cultural context. Formal education involves the acquisition of knowledge and understanding, concepts and skills within each subject area. Pupil should learn to describe, interpret, judge and apply their knowledge. Personal development of pupils is done in a range of spiritual, moral, social and cultural contexts. It involves for pupils an awareness of appropriate behaviour, and understanding of the environment in which they work and live and a development of individual identity. In practice these two tasks are inseparable within the school.

These two major objectives are developed in the context of a highlighted awareness of European reality, the characteristic feature of which is the richness of European cultures. This awareness and the experience acquired as a result of shared European life should lead to the development in pupils of behaviour showing clear respect for the traditions of each individual country in Europe, while at the same time preserving their own identities.

1.2. Subject-specific objectives

Mathematics instruction must progress systematically and create a lasting foundation for the assimilation of mathematical concepts and structures. The aim is to develop pupils' mathematical skills, such as creative, logical and analytical thinking. Pupils should develop the skills of formulating mathematical problems appropriately, then finding the solutions to the problems and finally presenting their methods and conclusions in a neat and orderly fashion. Problems that come up in day-to-day situations, and that can be resolved with the aid of mathematical thinking or operations, are to be utilised effectively.

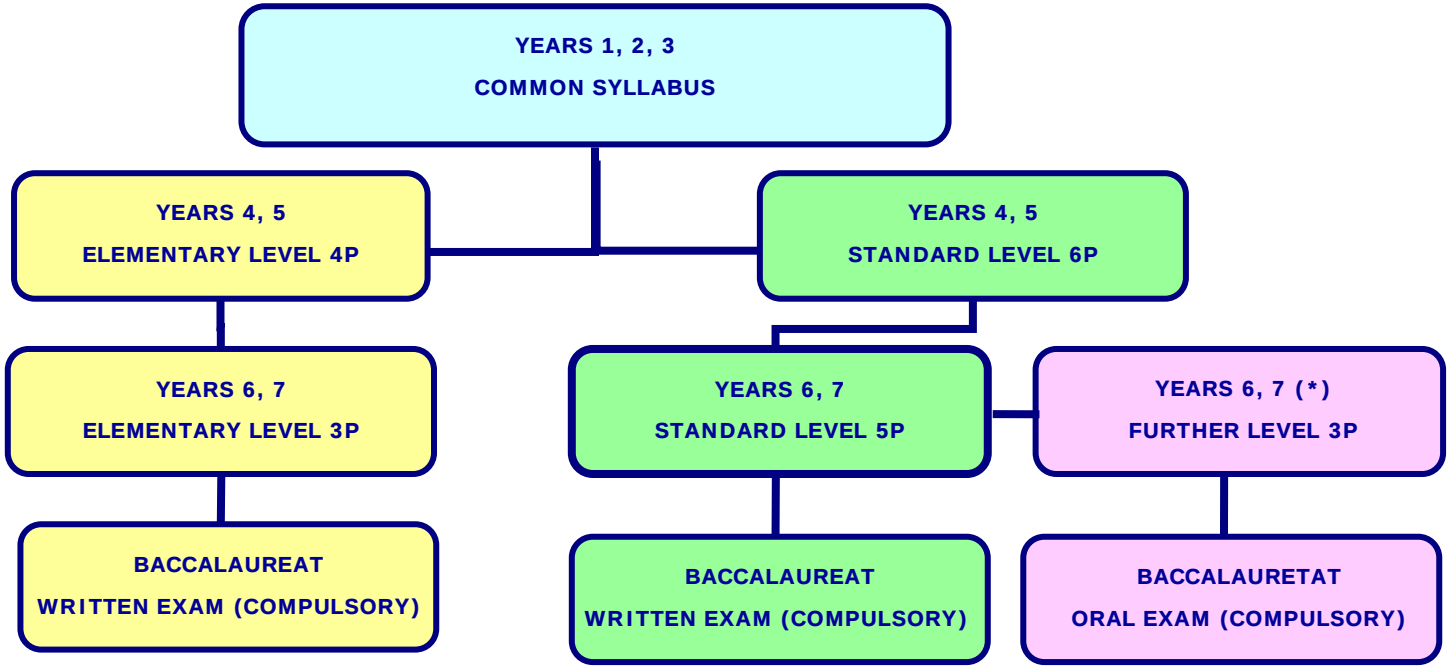
This syllabus of mathematics aims to improve the teaching of mathematics by guaranteeing more equality, and by updating the syllabus to correspond better to the new demands of the society.

The syllabus preserves the foundations of mathematics teaching and leaves the core of the subject unchanged but at the same time it has as a new objective the systematic implementation of modern technological tools in the teaching. It also aims to create a common vehicle for teaching while allowing the teachers the freedom to introduce the fundamental concepts of the syllabus according to their own teaching methods.

Also, this syllabus allows for differences in pupils' level of performance and enables them to excel. It eliminates the need for the pupil to master simple routines. This syllabus also places a great deal of emphasis on strategic thinking skills, as well as analysing results obtained.

It is important to underline that the syllabus is not based on the use of technological tools. On the contrary, purposeful and efficient use of these tools helps pupils to become confident in the fundamental mathematical concepts. It is also possible to differentiate the learning methods according to the age, level of studies chosen, and knowledge and skills of each pupil.

1.3. Structure of studies



(*) The further level course can only be studied in conjunction with the standard level (5p).

1.3.1 Elementary level

This course is intended for pupils who do not consider continuing with studies where mathematics plays an important role. Its purpose is to help pupils to understand the scientific and technological world surrounding them without putting too much emphasis on theoretical aspects of mathematics.

In the years 6 and 7 the 3 period course is normally preceded by the 4 period course in years 4 and 5.

1.3.2 Standard level

This course is intended for pupils who need mathematics in their higher level studies and because of this can benefit from a solid foundation and a good general knowledge of mathematics.

In years 6 and 7 the 5 period course is normally preceded by the 6 period course in years 4 and 5.

1.3.3 Further level

This course is only intended for pupils who have taken the 5 period course in years 6 and 7. Its purpose is to provide pupils with the knowledge sufficient for higher studies where mathematics has an important and fundamental role. The course requires dedication and the pupils are trained to solve problems with more varied methods.

The syllabus consists of two parts – one compulsory and the other optional - which allow for the incorporation of national syllabuses as well as entry requirements to institutions of higher education in different member states.

In year 6 the teacher shall include one of the options given in the syllabus in the optional part.

In year 7 the teacher shall include two of the options given in the syllabus in the optional part.

2. CONTENT

In this document the syllabus is presented in three columns.

The first column titled « *topics* » gives the content of the chapters.

The second column titled « *knowledge and skills* » states the objectives to be attained and defines clearly the techniques, concepts and strategies the pupil must understand and master without having any technological tool as a support.

The third column titled « *use of technological tool* » indicates the knowledge and skills required for effective use of technological tools associated with this syllabus.

Unlike in the syllabus for years 1, 2 and 3, the third column does not list possible teaching approaches which could be adopted when teaching the respective topics mentioned in the two previous columns. The third column here is an integral part of the syllabus defining the skills the pupil has to acquire to use the technological tools in order to perform calculation techniques, analyse problems, make conjectures, link concepts together, develop strategies and test results. This column also suggests the use of a technological tool in tests, exams and the Baccalaureate.

3. METHODOLOGY

3.1 Use of technological tool

Many students have difficulty understanding mathematical problems and appropriately applying their knowledge. Often they do not succeed in establishing a connection between their existing knowledge of mathematics and the method needed to solve a problem. Therefore, the fundamental aspect of this syllabus is the systematic use of a technological tool at all levels which:

- is the same in all European schools for all students and all levels of mathematics education from the 4th year;
- is sustainable over time because the software can be updated;
- integrates simultaneously and on a single platform; geometry, algebra, analysis, spreadsheet, drawing graphs, probability and statistics;
- ensures equity of use during class tests, examinations and baccalaureate.
- gives students the resources to devote themselves to actually solving problems and thereby highlights mathematical thinking, developing strategies and verification of results;
- allows an interdisciplinary approach, encouraging students to apply knowledge and skills in handling technological tools in other subjects such as physics, chemistry, biology, economics, sociology and geography.

The choice of technological tool to accompany this program is separately defined in a specification[1] and revised in light of developments in this area[2].

This essential aspect of the syllabus not only modifies pupil's learning techniques but it will also mean a profound change in the teaching methods used by the teacher. This technological tool will make it possible for the teacher to divide teaching in units, to adopt a dynamic and interactive approach and to introduce the basics for mathematical reasoning in numerous varying situations

Introduction of this tool promotes group work, the exchange of ideas and information and discussion on strategies to be applied. It gives the teacher a role of mediator in this exchange, in a class room which through the implementation of this methodology will become a laboratory of mathematics.

This syllabus aims by no means to see this technological tool as a simple help for performing calculations and technical tasks in mathematics. On the contrary, a well-considered use of this tool shall enable the pupil to gain a better understanding of mathematical structures intrinsically connected with the technical aspects of mathematics. It contributes to the understanding and not to the acquisition of techniques.

[1] Mathematics Syllabus Year 4 to Year 7: "Characteristics of the technological tool to be implemented" Ref.: 2010-D-571-en-2

[2] "Arrangements for acquisition of the 'calculator' foreseen by the new mathematics syllabuses" (approved by the Board of Governors of the European Schools on 14, 15 and 16 April 2010 in Brussels) Ref.: 2010-D-242-en-3

3.2 Exercises, techniques and problem solving

Problem solving plays an important role in the development of mathematical abilities as a key factor for stimulating reasoning. Examples and problems can be taken from everyday life. In addition, it is possible to use artificial situations as well as carry out research and conduct experiments.

In order to understand the basic philosophy of this syllabus of mathematics and to put problem-solving really into practice it is important to distinguish between an exercise or a technique and solving a real-life problem; acknowledging that the one cannot be done without the other. The fundamental objective of this syllabus is to recognise that both play a role and not to limit mathematics to the use of mechanisms.

An exercise or using a technique differs from solving a real-life problem in the following ways.

Exercise or mathematical technique	Real-life mathematical problem
The wording sets out what is to be done and often indicates the techniques to be used.	The wording can be open and at the start it is not yet clear what is being asked.
The path for finding the solution is unambiguous.	At first it is not always evident how to reach the solution.
The solution is obtained by using skills or mechanisms gained previously.	Solving the problem requires going into detail, seeing a relationship, reflecting, drafting a strategy on how to continue from the start.
It is possible to estimate the time required for obtaining the solution.	To estimate the time required for solving the problem is difficult, or even impossible.
The level of difficulty can be clearly defined and finding a solution is evident for those above that level. On the other hand, finding the solution is impossible for those who have not reached the level required.	The level of difficulty is not the only decisive factor. The problem can be simple, interesting and does not necessarily require skills acquired previously. The problem can be solved by persons with different level of competences.

Solving a real-life problem involves different steps and using basic or universal strategies.

The steps can be described as follows:

1. Understanding the problem
2. Drafting a plan
3. Carrying out the plan
4. Reflecting on the solution obtained.

Basic strategies include the following among others:

1. Examining all possible cases
2. Choosing appropriate mathematical notation.
3. Drafting a strategy
4. Making an outline, a diagram, a graphical presentation
5. Making reasoning or a proof.

According to these ideas this syllabus of mathematics intends to establish a justified balance between mastering the fundamental and necessary techniques in mathematics and the development of mathematical reasoning through solving real-life problems. These two aspects are inseparable in the syllabus. In their daily work in the class room the teacher is free to balance between these two pillars of mathematics. However, it is in their responsibility to abide with the contents of the three columns and prepare the pupils according to the terms for tests, exams and the Baccalaureate defined in the following chapter.

4. ASSESSMENT OF LEARNING OUTCOMES

4.1. Functions and principles

Assessment is both a formative and a summative process.

Formative assessment of learning outcomes is an ongoing process. Its purpose is to provide information about pupils' learning. It should also be a basis for pupils' further achievement and plays an important role for pupils, parents or guardians and School in the provision of educational guidance for pupils. Assessment of learning outcomes need not involve the award of a mark reflecting performance in every case and it should

not be punitive, but it should evaluate performance. For teachers, the assessment of learning outcomes provides an opportunity to review the objectives, methods and results of their teaching.

Summative assessment provides a clear statement of the knowledge and skills possessed by a pupil at a particular point in time.

The following general principles of assessment of learning outcomes should be observed:

- performance against all the objectives as defined in the syllabus should be assessed. This will be done through the knowledge and skills set out in the syllabus
- assessment must relate to work which has been covered in the course
- all types of work done by the pupil on the course should be a part of the assessment process - e.g. oral and written contributions, class tests, practical work
- pupils should be aware of the work to be done and the standards to be achieved in order to attain each level in the assessment scale
- pupils should know how their performance compares with other pupils, in the same or other sections; this requires co-ordination between the teachers of the same and different sections to ensure comparability.

4.2. Assessment specific to Mathematics

4.2.1. Summary of assessment rules

In years 4 to 6 of secondary.

Teachers assess the progress made by pupils during the year by giving two sets of marks, an A mark and a B mark, at the end of each semester. These marks can be given in whole or half marks and are determined as follows:

- A mark: it reflects all aspects of student performance, both oral and written, which are not a part of the B mark. Work done at home can be included in this mark;
- B mark :
    - corresponds in year 4, for each of the semester reports, to the average score of the two B assessments taken each semester; these assessments will consist of two tests taken in lesson time or one such test and a semester examination;
    - corresponds in year[3] 5, for the first semester report, to the mark obtained in the 1st semester examination (harmonised or not) and for the second semester report, to the mark obtained in the harmonised 2nd semester examination;

[3] Harmonised Exam at the end of the 5th year and the written examinations leading to marks B in the 5th year with Annexe III. Ref.: 3512-D-97

- corresponds in year 6, for the first semester report, to the mark obtained in the 1st semester examination and for the second semester report, to the mark obtained in the 2nd semester examination;

In year 7 of secondary.

Progress made by pupils is assessed through:

- A mark: given at the end of each semester. The mark reflects all aspects of student performance, both oral and written, which are not a part of the B mark. Work done at home can be included in this mark;
- B mark: corresponding to the marks obtained in the part examinations of the Baccalaureate according to the Arrangements for implementing the Regulations for the European Baccalaureate;
- the mark obtained in the written Baccalaureate exam

All these marks are expressed to one decimal place.

The details of the current rules on assessment can be obtained in the following documents on the website of the European Schools, at **www.eursc.eu**

- Digest of decisions of the Board of Governors
- General Rules of the European Schools
- Provision concerning the Harmonised Exam at the end of the 5th year
- Provision concerning the European Baccalaureate

4.2.1. Specific assessment resulting from the introduction of technological tools

The introduction of technological tools for this syllabus must naturally affect the methods of assessment. However, this specific assessment must be done within the existing regulatory framework. It is simply an additional element that a teacher must take into account when assessing and determining the final mark of students. This overall final mark will continue to reflect all elements that are relevant in assessing the academic progress of each student.

Pupil's A mark, from years 4 to 7

An assessment of a pupil's mastery of skills and use of technological tools is an additional element which the teacher must take into account when determining the A mark of a pupil. It is for teachers themselves to decide on how the mastery of technological tools should be reflected in this mark, bearing in mind the pupil's age and the level of course being followed.

Pupil’s B mark, from years 4 to 7

To meet the basic philosophy of this syllabus, the B marks must evaluate

on the one hand:

the skills of students in mastering, understanding and implementing the techniques and basic concepts of mathematics without using any technological tool – by means of a "pen and paper" assessment.

on the other:

the ability to apply technological tools within the context of solving exercises, problems, reasoning or mathematical proofs. Resolving these issues should not be oriented towards the exclusive use of a technological tool and the resolution of certain parts of these exercises should be perfectly possible and feasible without this aid.

The weighting between these two assessments must take into account the age and level of pupil and it will be the responsibility of the European Schools to harmonise all tests, examinations and the baccalaureate according to the table below.

THE B-TESTS IN THE CLASSES S4 to S7

Class	1st semester		2nd semester	
4th class mathematics 4p/week	1st B-test without a tool	2nd B-test with a tool	1st B-test without a tool	2nd B-test with a tool
4th class mathematics 6p/week	1st B-test without a tool	2nd B-test with a tool	1st B-test without a tool	2nd B-test with a tool
5th class mathematics 4p/week	December exam :	1 period without a tool 1 period with a tool	Harmonised exam in June:	1 period without a tool 1 period with a tool
5th class mathematics 6p/week	December exam :	1 period without a tool 2 periods with a tool	Harmonised exam in June:	1 period without a tool 2 periods with a tool
6th class mathematics 3p/week	December exam :	1 period without a tool 2 periods with a tool	Exam in June:	1 period without a tool 2 periods with a tool
6th class mathematics 5p/week	December exam :	1 period without a tool 3 periods with a tool	Exam in June:	1 period without a tool 3 periods with a tool
6th class mathematics further level 3p/week	First semester B-test over 2 periods :	Minimum 1 period without a tool	Second semester B-test over 2 periods :	Minimum 1 period with a tool
7th class mathematics further level 3p/week	First semester B-test over 2 periods :	Minimum 1 period without a tool	Second semester B-test over 2 periods :	Minimum 1 period with a tool

THE PREBAC AND THE BACCALAUREATE

7th class	**Prebac**		**Baccalaureate**	
7th class mathematics 3p/week	Prebac :	1 hour without a tool 2 hours with a tool	Baccalaureate :	1 hour without a tool 2 hours with a tool
7th class mathematics 5p/week	Prebac :	1 hour without a tool 3 hours with a tool	Baccalaureate :	1 hour without a tool 3 hours with a tool
7th class mathematics further level 3p/week 3p/sem.	No Prebac		Oral exam:	With or without tool, the indication is given by the teacher separately on each subject.

4.2.3 Examining the advanced mathematics course

It is the responsibility of the teacher to clarify whether the use of a calculator is allowed during B tests given in s6 and s7 by referring to the table above.

Each oral examination question should clearly state whether the use of the calculator is allowed or not. Partial use of the calculator during an oral examination is not allowed.
If the oral examination question does not allow the use of the calculator then the candidate must hand in their calculator to the teacher after the choice of question and, if the use is allowed, the teacher must check that it is in exam mode before the candidate goes to the preparation room.

Unlike the preceding compulsory part of the program the description of each optional topic gives only a general overview of the content. Small adjustments in the content, linked to specific programs or requirements of national universities in different countries of the European Union remain possible. It is up to the teacher to make the necessary changes.

However, for the sake of readability and comparability of this part of the program, teachers in charge of this course must keep an accurate record of the adjustments made to the chosen options. This record will accompany the oral exam questions forwarded to the inspector responsible for mathematics in the European Schools. This will ensure that all such information (statement of the subject matter and the oral exam) is available to external examiners appointed for the oral tests.

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4.2.4 Criteria for evaluating the advanced mathematics oral exam

The oral examination gives the students an opportunity to express themselves on a mathematical topic. "Besides the validity of the answer, we attach paramount importance to the basis of the argument and the relevance of justification without neglecting the quality of oral expression."

Mathematics requirements: (2 +6 = 8 points total)

- **The plan of the presentation:** (2 points)

The student must show that the topic in which the question is set is familiar and justify the approach they will implement. Specifically, they must:

  - identify the topic;
  - clarify the concepts and methods being implemented;
  - show the ability to set the given problem in a mathematical context.

- **The development of the solution:** (6 points)

During the solution of the question the student must:

  - recall necessary definitions;
  - use appropriate vocabulary;
  - show a consistent, logical approach;
  - show mastery of any computational techniques that are used (with or without a calculator).

- **Additional questions**

  - They are not predetermined and depend on the quality of the presentation of the student.
  - They are designed to:
    - assess the knowledge level of students on the topic of the question chosen(mainly if the student development can be improved;
    - broaden the question (extrapolation).

Practical requirements: (2 points)

During the solution of the question they will also be evaluated on the following:

- clear communication skills and use of an appropriate vocabulary;
- good use and management of the blackboard;
- ability to adapt to an oral examination.