European Schools

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Pedagogical development Unit

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S6P3 MATHEMATICS SYLLABUS SECONDARY 6th YEAR

Elementary level 3 period/week course

APPROVED BY THE JOINT TEACHING COMMITTEE ON THE 4th AND 5TH OF FEBRUARY 2010 IN BRUSSELS

Entry into force in September 2010

ANALYSIS (for guidance: 55 periods)

TOPIC	KNOWLEDGE & SKILLS	USE OF TECHNOLOGY
Revision and consolidation of the prerequisites for the analysis	*Pupils must be able to and/or understand:* • find the domain and range of a function • plot the graph of a function • calculate the gradient of a linear function • understand the properties of the tangent to a circle • recognize the shapes of the graphs of the following functions from their equations in a Cartesian coordinate system: o $f(x) = ax + b$ ($a \in \mathrm{IR}^*$, $b \in \mathrm{IR}$) o $f(x) = ax^2 + bx + c$ ($a \in \mathrm{IR}^*$, $b, c \in \mathrm{IR}$) o $f(x) = \frac{ax + b}{cx + d}$ ($a, b, d \in \mathrm{IR}$, $c \in \mathrm{IR}^*$) o $f(x) = \sin x$ o $f(x) = \cos x$ o $f(x) = \tan x$ • determine algebraically or graphically : o the zeros (roots) of these functions o coordinates of the points of intersection of graphs of functions of degree 2 or less • solve systems of linear equations	*Pupils must be able to and/or understand:* • draw the graph of a function using a suitable window and units • use CAS to find the solutions of an equation(including trigonometric equations of degree greater than 2 and those with rational coefficients) • Solve the intersection of trigonometric and rational functions only with CAS.

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Sequences and Series	*The object of this unit is to solve practical concrete problems, using arithmetic or geometric progression For example, those found in financial mathematics (simple interest, compound interest, depreciation of property, inflation, trade) in physics (radioactivity) or biology (cell division).* *Pupils must be able to and/or understand:* • use a recurrence relation to define an arithmetic or geometric sequence • recognize an arithmetic or geometric progression from its graph or from data in a table and give the first term, and common difference or common ratio • give the general term of an arithmetic or geometric progression as a function of *n*	*Pupils must be able to and/or understand:* • introduce a progression in the calculator and search for terms thereof (algebra window or spreadsheet) • represent the terms of a progression (ordered term depending on the rank on the abscissa) • identify and justify that a progression, given in a table, is arithmetic or geometric and determine the expression, by induction or explicitly, of such a progression • study graphically the variations of progressions (arithmetic or geometric or of another form) • determine the limit of an arithmetic or geometric progression • calculate sums of consecutive terms of arithmetic or geometry progression and study the limit of such sums

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Transformations of Graphs (and algebraic properties of functions)	*In this section, the functions already familiar to the students will be enriched using some essential concepts. The student will be able to make use of this knowledge to solve practical problems by using the properties of known functions to find the properties of new functions* *Pupils must be able to and/or understand:* • for polynomial functions of degree less than or equal to 4 : o describe graphically the variations(the increasing or decreasing nature) and the asymptotic behaviour of a function o establish whether a function is odd, even or neither using the equalities $f(-x)=f(x)$ or $f(-x)=-f(x)$ and interpret the result on a graph o recognize the properties of symmetry, (rotational about the origin for odd functions and reflective in the x-axis for even functions) and interpret the result algebraically.	*Pupils must be able to and/or understand:* • use symmetry observed in the graph of a function *f* check by establishing whether or not one of the following hold true $f(-x)=f(x)$ or $f(-x)=-f(x)$ • determine the limit of *f (x)* as *x* approaches of a given value or for $x \to \pm\infty$ • determine the zero(s) and intersections points of such functions • transform a graph using the following transformations for real coefficient *k* : o $x \mapsto f(x+k)$ o $x \mapsto f(x)+k$ o $x \mapsto k \cdot f(x)$ o $x \mapsto f(k \cdot x)$ • explain the link between the graphs of functions $f(x)$ and $\lvert f(x) \rvert$

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Periodic functions	*Modelling cases such as sound waves, daily or seasonal temperature fluctuations, cycles of ovulation, the coefficients of the tides.* *Pupils must be able to and/or understand:* • interpret graphs of functions related to circular functions, such as $x \to a\sin(bx+c)$ *or* $x \to a\cos(bx+c)$, in terms of amplitude, period, phase shift and roots	*Pupils must be able to and/or understand:* • predict intervals on a graph of a function *f* and check their prediction using $f(x+T)=f(x)$, where *T* corresponding to the expected period • manipulate the sine and cosine functions to find the equation of the graph of the function using a scatter plot
Predicting the behaviour of a function	*It is essential to apply the tools of this paragraph to the solution of practical problems, such as economics (cost, marginal revenue or profit), optimization and applications to science.* *At the end of this chapter, students should be able to fully study a function, and using all the concepts covered in the analysis section (domain, zero, variations, extreme, limits and asymptotes, symmetry and parity), particularly with the help of the CAS tool.* *Pupils must be able to and/or understand:* • explain that the tangent to the graph of a function can be interpreted as the limit of a family of intersecting lines • to explain that the limit of a sequence of gradients of progressively shorter chords gives the gradient of the tangent to the curve	*Pupils must be able to and/or understand:* • sketch the tangent to the graph of a function at a given point and find its equation • determine the derivative of any given function • plot the graph of a function and its derivative function on a given domain • use the derivative to study the variation of a function and determine its extreme points

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	• sketch the tangent to the graph of a function at one of its points and find its equation • explain that there is a function that gives, for a given function, the values of the gradient at every point : the derivative • an equation of the tangent to the graph of a function *f* at the point where x=a, *has* the form $y = f'(a)\cdot(x-a)+f(a)$ • explain and use the link between the following : o the sign of the derivative of a function *f* (possibly from the graph of the derivative function); o variations (increasing/decreasing nature) of this function *f;* o the shape of its graph	• recognize and find the stationary points of a function both graphically and algebraically • determine the equation of a function $f(x)$, for each type of function previously studied, given sufficient information made up from a combination of for example: • the graph • the coordinates of zeros • the coordinates of the y intercept • coordinates satisfying the function • odd or even • stationary values • values of the gradient at certain points • the graph of the derivative function

STATISTICS (for guidance: 10 periods)

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Revision and consolidation of the prerequisites for statistics	*Pupils must be able to and/or understand:* • Perform calculations involving percentages and frequencies	*Pupils must be able to and/or understand:* • use the basic functions of a spreadsheet (operations on the contents of cells, knowing the differences between relative and absolute references) to transform a frequency table to a relative frequency table (also in the form of percentages), and vice versa

Contingency tables (or two way tables)	*Avoid teaching formally; the mathematical skills have to be mastered in a practical context using examples from fields such as data processing in economics, geography, physics, biology etc.*
	
	Pupils must be able to and/or understand:
	• construct, complete and interpret data given in contingency tables (including the totals of rows columns)
	• build relative frequency contingency tables with frequencies
	  o relative to the total frequency
	  o relative to the sum of lines and of columns
	• construct a contingency table from the relative frequency table and the total frequency
		Pupils must be able to and/or understand:
		• use a spreadsheet to construct these types of frequency and relative frequency distributions

PROBABILITY (for guidance: 25 periods)

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Revision and consolidation of the prerequisites for the study of probability	*Pupils must be able to and/or understand:* • explain that in a large number of identical and independent trials, the relative frequency of an event tends to a limit defined as probability of this event • calculate the probability of an event and use appropriately the following formulas : o $P(\neg E) = 1 - P(E)$ o $P(A \cap B) = P(A) \cdot P(B)$ for independent events o $P(A \cup B) = P(A) + P(B)$ for mutually exclusive events o $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ • model a simple situation with a probability tree (no more than 3 sets of branches on the tree)	*Pupils must be able to and/or understand:* • use all basic arithmetic operations of technological support to carry out the calculations they will have to handle
Counting and calculating probabilities	*No specific context will be given although it is noted that probability exercises will naturally take their inspiration from real life applications of the concepts covered in this course.* *Pupils must be able to and/or understand:* • explain the concept of conditional probability of *A* given *B* and apply the formula $P_B(A) = P(A \mid B) = \frac{P(A \cap B)}{P(B)}$ *in:* o a tree diagram o in a two way table	*Pupils must be able to and/or understand:* • calculate the number of : o arrangements, with repetition and without repetition, of *p* elements of a set containing *n* elements o permutations of *n* elements o combinations of *p* elements of a set containing *n* elements

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	• recognize situations of elementary combinatorial analysis (with or without replacement) and apply the appropriate model to solve problems leading to: o arrangements, with repetition and without repetition of a finite set o permutations without repetition of a finite set o combinations without repetition of a finite set • calculate probabilities such as those mentioned in the pre-requisites and those requiring the use of combinations • explain the concept of Bernoulli trials, (with success and failure) • recognize such an event and calculate the corresponding probabilities • explain the concept of a Bernoulli scheme • explain the concepts of finite discrete random variables and their probabilities • recognize random experiments which lead to a random variable X which follows a binomial distribution. • calculate binomial probabilities of the form $P(X = k)$.	• calculate a probability of the form $P(X = k)$ for a random variable X following a using a binomial distribution