The German Maths curriculum

E1 E2	Analysis I
Educational content	Keywords
Function concept and contemplation of elementary functional classes from lower secondary	Definition set, range, function term, -equation, -graph, symmetry, table of values, inverse function.
Exponential function: x -> a*b(x-d) + e	Access to reality-based examples: growth and decay processes, interest, duplication and half-life as a parameter, graph for b=2, 1/2, 10 and characteristics, compared with linear, quadratic and cubic functions.
Logarithms	Finding the log in addition to the root extraction as a second possibility of reversal of the exponentiation, logarithmic laws logb(a) = log10(a) / log10(b), judicious use of calculator.
Logarithmic functions x -> a*log10(x - d) + e	Revisiting the concept of inverse function, reversal of exponential function 10x , characteristics of logarithmic function.
Modelling of growth and process models	Modeling of processes from the natural, social or economics based on given data material for example from scientific or demoscopic investigations by exponential or other known functions, including by making use of different computers, exemplary comparison models and assessing their limits.
General sine function x -> a*sin(b x + c) + e	Radians, dilation/compression and displacement of the graph of the sine function, use of PC.
Limit of a function	Radicals as limits of nested intervals, irrationality, approximately determination of π by infinitesimal methods, asymptotic behaviour at functions.
Introduction of the derivative term	Rate of change of a funktion; slope of a graph difference quotient limit of the difference quotient (graphic is

Derivative of a function at/on a digit	enough) determination by algebraic simplification of the quotient infinitesimal perception. Calculation of derivative elementary derivative function functions: f(x)=x^n, nEZ, f(x)= √x, f(x)= sin (x) and f(x)= cos (x) link between geometric and algebraic perceptions derivative functions, higher derivative functions
Typical derivation calculi Functional examination with the help of the derivation calculi	Sum- and multiple rule Symmetry; monotonic -and bending behaviour; relative and absolute extreme points, inflection points (each necessity and sufficiency complete curve sketching on polynomial functions (primarily), but also examples from other function classes and function rallys.
Application of determination calculi	Extreme problems (also solutions with the method from lower secondary), determination of functions with claimed/predetermined properties, linearization of functions

Christian H. And Angelique W. p.43 & 44

Q1 / GK	Analysis II
Educational content	Keywords
Introduction for integral calculus	Calculation of surfaces areas by approximation and limiting processes, definition of definite integral as limit for upper and lower sum, development of the basic idea of the integral term as generalized summation in application contexts, analysis of the integral term (meaning of the narrowness and continuity of functions) Characteristics and application of the certain integral (sum rule and multiplication rule) Term of the primitive integral and antiderivative Fundamental theorem of the differential and integral calculus and primitive integrals, surface area calculation.
Extension and linking of differential and integral calculus	Investigation of complex functions, to developing and applying the product and chain rule (linear composition) Linear substitution as a convenience method of integration Working out of the relationship to the chain rule. Understanding handling of the developed calculi of the analysis of the known functional classes: Polynomial functions, simple rational functions, exponential functions and simple trigonometrical functions
Application and deepening of differential and integral calculus	Investigation of functions Extremal problems Volume integral (rotation around the x-axis)

Q1 LK	Analysis II
Educational content	Keywords
Introduction to integral calcus	Calculation of acreages by approximation and limit value processes, definition of the particular integral as the limit value of the upper and lower sum, development of the basic idea of the integral term as generalized summation in application contexts, analysis of the integral term (meaning of the narrowness and continuity of functions) Characteristics and usage of the particular integral (sum and factor rule) Term of antiderivative and indefinite integral Fundamental theorem of differential and integral calcus and antiderivative integral Numerical integration
Extansion and nexus of differential and integral calcus	Product rule, quotient rule, chain rule, derivation and inverse function Sensible handling with the acquired calcus of Analysis in known functional classes: Polynomial functions, rational functions, exponential and logarithm functions, trigonometric functions Mathematization of accretion and decay processes Integration by parts, integration by linear substitution, connection to the product and chain rule, improper integrals

Usage and deepening of differential and integral calcus	Extremal problems (including integration), volume integral, integral term in application context, approximation of functions, asymptotic behavior, approximation by polynomial, compensation curve as mathematic models for given data

educational programme grammar school subject maths Q2 GK	**linear algebra/ analytical geometry**
Educational content	Keywords
analytical geometry	vectors lines and planes (parametric representation and coordinate representation) relation of the location of points, lines and planes within space for consolidation there are families of plane and line surfaces to be looked at dot product length of a vector angle between two vectors, orthogonality normal form from planes regulations of distances (except regulation of distances for skew lines) cutting angles of lines and planes within space
linear systems of equation	usages of the dot product usages of systems of equation systematically solution procedure, structure and geometric interpretation of the solution set

Julia W. p.51

Q2 LK	linear algebra/ analytical geometry
Educational content	Keywords
Analytical geometry	Vectors straight lines and planes (parametric equation and coordinatic equation) Lagebeziehungen von Punkten, straight lines and planes in a space, family of straight lines, family of planes, scalar product with applications, length of vectors, angles between two vectors, orthogonality Vector product with applications Normal form of straight line equations and plane equations, distance regulations, bias angle
System of linear equations	Applications of systems of linear equations Systematic solution procedure, structure and geometric interpretation of the solution set
Vector space	Term of vector space Radix and dimension
Matrices and linear images	Term of matrix, product of matrices, inverse matrix, applications in the geometry and at not-geometric problems

Q3 GK	Stochastic
Educational content	Keywords
Basic terms of stochastic	Random experiments and events Absolute and relative frequency, frequency distribution and their graphical representation Measures of central tendency and variation, quantile Concept of probability (Laplace-Probability has to be recognised as a special case) Empiric law of large numbers
Calculation of the probability	Addition rule Path rules (sum, product) Independence of two events Conditional probability
Combinatorial counting problems (Counting procedure should only be dealt with as far as it is necessary for the understanding of the following questions)	Ordered sample (with/without putting back) Disordered sample (without putting back)
Probability distribution of random variables	random variable, expected value, variance and standard deviation of a random variable Bernoulli- chain Binomial distribution
Hypothesis testing	One- sided and two- sided test Acceptance region, rejection region Mistakes of first and second kind

Jana M. P.55

Q3 LK	Stochastic
Educational content	Keywords
Essential terms of stochastics	random experiments and occurrences absolute and relative frequencies, frequency distribution and their graphic representation measure of location and dispersion, quantile Probability term (Laplace-probability should be realised as outlier) empirical law of big numbers
Calculation of probabilities	additive law of probability law of calculating the probability of multi- level random experiments (sum, product)
Combinatorial counting problems (Counting procedures should only be learned as much as they are needed for understanding the following central issue.	independence of occurrences conditional probability
Probability distribution of random parameter ranges	ordered sample (with/without putting back) unsorted sample (without putting back)
Particular probability distributions	random parameter range, actuarial expectation, variance, standard deviation probability distribution of several random parameter ranges (sum or product) Bernoulli distribution Binomial distribution
Hypothesis test	Normal distribution (density and distribution function) Approximation formula of the binomial distribution One- and two-sided test Area of hypothesis, area of

	dismissal, first or second kind of mistake, operation characteristic

Teresa H. p.56

Q4 Examples for coursesubjects

Course subjects and possible/potential content of the lessons:

Usual differential equation
Richtungsfeld, differential equation in main order/arrangement, existence- and monosemysentence, elementary methods of solution, differential equation in second order/arrangement

Power series
Polynomial functions as approximation functions, exponential series, power series, taylor‘s formula, taylor series

Numerical approximation process/approximation of functions
Interpolation through polynomial, approximation method, fixed point, Newton-Raphson method, numerical integration (chord- trapezium method, Simpson‘s rule), Regressionsmodelle

Circle and sphere
Circle in plane, sphere, plane and line, locationrelation between sphere, planes and lines, intersecting set

Conic sections
Vector equation of doublecones, vertical equations of conic sections, arts of conic sections (circle, parabola, ellipse und hyperbola)

Practical stochastics
Operations-charakteristic (use of binomial distribution - portiontest, use of normal distribution - mean value test, Gütefunktion), assessment of the mean value of a normally distributioned base, sign test, Chi-Square-Test, Monte-Carlo-Method, Markow-Chains, simulations

Determinants and matrices
System of linear equations and determinants, determinants and volume, transformations of matrices und determinants

Affine transformations
Definition and qualitys of affine transformations, portrayal of affine transformations, use in der fractal geometry

Mathematical structures and the process of proofs
Groups and solid figures; process of the proof: directly and indirectly proof; complete induction

Complex numbers
Introduction, definition and portrayal of complex numbers; to calculate with complex numbers; use of comblex numbers