Mathematics

GRADE 12

SLOs for Assessment Key: **1**.Assessible / Attainable - (Not included in drop down list) **2. Ambiguous (assessable in longer run) - (Grey)** 3. Not assessable in Summitive - (Grey) 4. Repetitive (with in same grade) - (Grey) 5. Repetitive (with in same learning level) - (Grey)

Domains	Standards	Benchmarks	Topic/Title	NC SLO #		NCP (2022) - SLO	Code	Status of SLOs	SLOs for Assessment	Cognitive Domain
			Functions and Graphs	[SLO: M-12-A-01]		Recall • function as a rule of correspondence, • domain, co-domain and range of a function, • one to one and onto functions.	n	Grade 11 SLO		Remember
				[SLO: M-12-A-02]		Know linear, quadratic and square root functions. Inverse Function	m	Grade 11 SLO		Remember
				[SLO: M-12-A-03]		Define inverse functions and demonstrate their domain and range with examples.	n	Grade 11 SLO		Remember
			Graphical Representation of Functions	[SLO: M-12-A-04]		Sketch graphs of =>linear functions (eg. y = ax + b), => non-linear functions (e.g. $y = x^2$).	n	Grade 11 SLO		Understand
				[SLO: M-12-A-05]		Plot the graph of the function $y = x^n$, here n is => a+ ve integer, => a— ve integer ($x \neq 0$), => a rational number for $x > 0$	m	Matched SLO		Understand
				[SLO: M-12-A-06]		Plot graph of quadratic function of the form $y = ax + bx + c$ ($a \neq 0$), b, c are integers.	n	Matched SLO		Understand
				[SLO: M-12-A-07]		Draw graph using factors.	M	Matched SLO		Understand
				[SLO: M-12-A-08]		Predict functions from their graphs (use the factor form to predict the equation of a function of the type $f(x) = ax^2 + bx + ¢$ (if two points where the graph) crosses x axis and third point on the curve, are given). Intersectin Graphs	M	Grade 11 SLO		Understand
				[SLO: M-12-A-09]		Find the intersecting point graphically when intersection occurs between => A linear function and coordinate axes, =>Two linear functions, =>A linear and a quadratic function.	m	Grade 11 SLO		Understand
				[SLO: M-12-A-10]		Solve, graphically, appropriate problems from daily life.	R	Grade 11 SLO		Apply
				[SLO: M-12-A-11]	Analysis	Classify the functions as algebraic and transcendental functions	n	Matched SLO		Understand
				[SLO: M-12-A-12]		Describe various transcendental functions, such as: =>Trigonometric functions, => Inverse trigonometric functions, => Logarithmic function, => Exponential function	m	Matched SLO		Understand
			Logarithmic function	[SLO: M-12-A-13]	may not be assessed	Demonstrate an understanding of logarithms.	R	New SLO	**Not assessable in summative**	Understand
				[SLO:M-12-A-14]		Derive and apply product, quotient, and power laws of logarithms	n	New SLO		Apply
			Exponential function	[SLO: M-12-A-15]		Graph and analyse exponential and logarithmic function Apply the concept of exponential function to find compound interest	n	New SLO		Analyse
				[SLO: M-12-A-16]		Solve problems that involve exponential and logarithmic Equations	n	New SLO		Apply
				[SLO: M-12-A-17]		Identify the domain and range of fundamental transcendental functions. Graphical Representation	n	New SLO	**Ambiguous**	Understand
				[SLO: M-12-A-18]		Draw the graph of modulus function	n	New SLO		Apply
				[SLO: M-12-A-19]		Interpret the relation between a one-one function and its inverse through a graph.	n	New SLO		Apply
				[SLO: M-12-A-20]		Demonstrate the transformations of a graph through horizontal shift, vertical shift, and scaling.	m	New SLO		Understand

Numbers and Algebra	Interpret functions, calculate rate of change of functions, apply differentiation, integrate analytically, Utilise integration, solve simple ordinary differential equations, solve nonlinear equations numerically by simple iterative formula.	**Benchmark VII**: Students will be able to Express Function plot and interpret the Graphs of functions. Fundamental transcendental functions, their domain and range. Evaluate limits of different algebraic, exponential, and trigonometric functions **Benchmark VIII:** Students will be able to differentiate and integrate a function with the emphasis on practical applications. **Benchmark IX**: Students will be able to find Solution of differential equations and apply first-order separable ordinary differential equations of degree one. **Benchmark X**: Students will be able to solve nonlinear equations in one variable and definite integral by numerical methods	**Limit of a Function**	[SLO: M-12-A-21]		Demonstrate and find the limit of a sequence and a function.	n	Modified(rephrased) SLO		Understand
				[SLO: M-12-A-22]		State and apply theorems on limit of sum, difference, product and quotient of functions to algebraic, exponential and trigonometric functions.	n	Matched SLO		Remember
			Continuous and Discontinuous Functions	[SLO: M-12-A-23]		Demonstrate and test Continuity, discontinuity of a function at a point and in an interval.	m	Modified(rephrased) SLO		Understand
				[SLO: M-12-A-24]		Apply concepts of transcendental functions, limit of a function and its continuity to real world problems such as (growth and decay, finance, economics, surveying, navigation, astronomy, growth rate of sales, rate of change in sales, predicting long-term stock prices).	m	New SLO		Apply
				[SLO: M-12-A-25]		Calculate inflation over a period of time.	m	New SLO		Apply
				[SLO: M-12-A-26]		Calculate depreciation with the help of straight-line method, sum of years digit method and production unit method	m	New SLO	**Ambiguous**	Apply
			Gradient of a curve	[SLO: M-12-A-27]		Recognize the meaning of the tangent to a curve at a point.	m	New SLO		Understand
				[SLO: M-12-A-28]		Calculate the gradient of a curve at a point.	n	New SLO		Apply
				[SLO: M-12-A-29]		Identify the derivative as the limit of a difference quotient.	m	New SLO		Understand
				[SLO: M-12-A-30]		Calculate the derivative of a given function at a point.	n	New SLO		Apply
				[SLO: M-12-A-31]		Estimate the derivative as rate of change of velocity, temperature and profit.	n	New SLO		Apply
			Derivative of a Function	[SLO: M-12-A-32]		Recognize the derivative function.	n	New SLO		Understand
				[SLO: M-12-A-33]		Find the derivative of a square root function.	n	New SLO		Apply
				[SLO: M-12-A-34]		Find the derivative of a quadratic function.	m	New SLO		Apply
				[SLO: M-12-A-35]		State the connection between derivatives and continuity.	m	New SLO		Remember
				[SLO: M-12-A-36]		State, prove and apply the constant rule, the coefficient rule, the power rule, the sum and difference rule, the product rule, the quotient rule for differentiation.	n	Modified(rephrased) SLO		Remember
				[SLO: M-12-A-37]		Extend the power rule to functions with negative exponents.	n	New SLO		Understand
				[SLO: M-12-A-38]	Apply	Combine the differentiation rules to find the derivative of a polynomial or rational function.	n	New SLO		Understand
				[SLO: M-12-A-39]	Apply	Apply rates of change to displacement, velocity and acceleration of an object moving along a straight line.	n	New SLO		Apply
			Further on Differentiation	[SLO: M-12-A-40]	Apply	Find the derivative of trigonometric and inverse trigonometric functions.	n	Modified(rephrased) SLO		Apply
				[SLO: M-12-A-41]	Apply	Find the derivative of exponential functions.	n	Modified(rephrased) SLO		Apply
				[SLO: M-12-A-42]	Apply	Find the derivative of logarithmic functions.	n	Modified(rephrased) SLO		Apply
				[SLO: M-12-A-43]		Apply differentiation to state the increasing and decreasing functions.	N	Modified(rephrased) SLO		Apply
				[SLO: M-12-A-44]		Apply differentiation to find equations of tangent and normal to a curve at a point.	n	Matched SLO		Apply
				[SLO: M-12-A-45]		Apply concepts of Differentiation to real world problems such as (profits on diminishing returns, environmental factors, financial investments, population growth, spread of diseases, movement of particles, time-speed in transportation, structural stress, material required viz a viz changes in construction).	n	New SLO	**Ambiguous**	Apply
			Higher-Order Derivatives	[SLO: M-12-A-46]	Apply	Find higher order derivatives of algebraic, implicit, parametric, trigonometric, inverse-trigonometric, exponential and logarithmic functions.	N	Matched SLO		Apply
			Applications of Derivatives	[SLO: M-12-A-47]		Describe the ability to approximate functions locally by linear functions. (Linear approximations of square root functions, trigonometric functions)	m	New SLO		Understand
				[SLO: M-12-A-48]		Explain differentials and draw a graph that illustrates the use of differentials to approximate the change in a quantity.	n	New SLO		Remember
				[SLO: M-12-A-49]		Calculate the relative error and percentage error in using a differential approximation. (Volume of a cube and sphere)	n	New SLO		Apply

			Extreme Values	[SLO: M-12-A-50]		Illustrate Global extrema (absolute extrema) and local extrema (relative extrema)	n	Modified(rephrased) SLO		Apply
				[SLO: M-12-A-51]		Find the extreme values by applying the second derivative test.	R	New SLO		Apply
				[SLO: M-12-A-52]		Explain how to find the critical points of a function over a closed interval.	M	New SLO		Remember
				[SLO: M-12-A-53]		Describe how to use critical points to locate absolute extrema over a closed interval.	M	New SLO		Understand
				[SLO: M-12-A-54]		Apply derivatives to real-world problems to find the maximum and the minimum values of a function under certain conditions.	n	New SLO		Apply
				[SLO: M-12-A-55]		Apply the concept of higher order derivatives to real life problems (such as transportation devices, cars, planes, roller coasters, rate of spread of a disease, rate of improvement of performance in psychology, automobiles, radar guns, economics).	n	New SLO		Apply
			Integration I	[SLO: M-12-A-56]		Find the general antiderivative of a given function.	R	New SLO		Understand
				[SLO: M-12-A-57]		Recognize and use the terms and notations for antiderivatives.	n	New SLO		Understand
				[SLO: M-12-A-58]		State the power rule for integrals.	M	New SLO		Remember
				[SLO: M-12-A-59]		State and apply the properties of indefinite integrals.	M	New SLO		Apply
				[SLO: M-12-A-60]		State the definition of the definite integral.	n	New SLO		Remember
				[SLO: M-12-A-61]		Explain the terms integrand, limits of integration, and variable of integration.	n	New SLO		Understand
				[SLO: M-12-A-62]		State and apply the properties of definite integrals.	n	New SLO		Apply
				[SLO: M-12-A-63]	understand/application	State and apply Fundamental Theorem of Calculus to evaluate the definite integrals.	n	New SLO		Apply
				[SLO: M-12-A-64]		Describe the relationship between the definite integral and net area.	n	New SLO		Understand
				[SLO: M-12-A-65]		Find the area of a region bounded by a curve and lines parallel to axes, or between a curve and a line, or between two curves.	R	New SLO		Apply
				[SLO: M-12-A-66]		Find Volume of revolution about one of the axes.	n	New SLO		Apply
				[SLO: M-12-A-67]		Demonstrate trapezium rule to estimate the value of a definite integral.	n	New SLO		Understand
				[SLO: M-12-A-68]		Apply concepts of Integration to real world problems such as (volume of a container, consumer surplus and producer surplus, growth rate of a population, investment return time period, drug dosage required by integrating the concentration).	n	New SLO		Apply
			Mechanics Kinematics of motion in a straight line	[SLO: M-12-A-69]		Recognise distance and speed as scalar quantities, and displacement, velocity and acceleration as vector quantities.	n	New SLO		Understand
				[SLO: M-12-A-70]		Sketch and interpret displacement–time graphs and velocity– time graphs	n	New SLO		Apply
				[SLO: M-12-A-71]		use differentiation and integration with respect to time to solve simple problems concerning displacement, velocity and acceleration	n	New SLO		Apply
				[SLO: M-12-A-72]		use appropriate formulae for motion with constant acceleration in a straight line	n	New SLO		Apply
				[SLO: M-12-A-73]		Apply the concept of mechanics to real life problems (such as motion of vehicles on roads, Projectile motion, free fall motion, relative motion animation)	n	New SLO		Apply
			Integration II Techniques of Integration	[SLO: M-12-A-74]		Utilise trigonometric relationships to evaluate integrals.	n	New SLO		Apply
				[SLO: M-12-A-75]		Integrate functions involving the exponential and logarithmic functions.	n	New SLO		Apply
				[SLO: M-12-A-76]		Identify when to use integration by parts to solve integration problems.	S	Modified(rephrased) SLO		Understand
				[SLO: M-12-A-77]		Apply the integration-by-parts formula for definite integrals.	R	Modified(rephrased) SLO		Apply
				[SLO: M-12-A-78]		Solve integration problems involving trigonometric substitution	n	Modified(rephrased) SLO		Apply
				[SLO: M-12-A-79]		Integrate a rational function using the method of partial fractions.	M	Modified(rephrased) SLO		Apply
				[SLO: M-12-A-80]		Apply concepts of integration to real life word problems (such as area between curves, average value of a function, distance velocity, acceleration, growth rate of population, moment of inertia, vector calculus to measure sensor network).	R	New SLO		Apply
			Differential Equations	[SLO: M-12-A-81]		Identify and construct first order differential equations from practical situations. Solution of Differential Equation	n	Modified(rephrased) SLO		Understand
				[SLO: M-12-A-82]		Solve separable differential equations of first order and first degree of ¬ separable variable equations ¬ Homogeneous equations	M	Modified(rephrased) SLO		Apply
				[SLO: M-12-A-83]		Apply concepts of first order differential equations to real life word problems (such as population growth and decay, Cooling/Warming law, flow of electricity, series circuits, economics and finance, radioactive decay).	M	Modified(rephrased) SLO		Apply
			Numerical Solution of Nonlinear Equations	[SLO: M-12-A-84]		Analyse the searching of roots of an equation by graphical means and/or searching for the sign change.	N	New SLO		Analyse
				[SLO: M-12-A-85]		Explain the basic principles of solving a nonlinear equation in one variable.	M	New SLO		Understand
				[SLO: M-12-A-86]		Calculate real roots of a nonlinear equation in one variable by bisection method, regular-falsi method, Newton Raphson method.	N	Matched SLO		Apply
				[SLO: M-12-A-87]		Apply concepts of nonlinear equations to real life word problems (such as chemical reactions, regulation of heart beats, electronic circuits, and cryptography).	R	New SLO		Apply
			Analytical Geometry	[SLO: M-12-B-01]		Find the condition of concurrency of three straight lines.	m	Matched SLO		Apply
				[SLO: M-12-B-02]		Find the equation of median, altitude and right bisector of a triangle.	n	Matched SLO		Apply

Geometry	Students will be able to; 1. Apply characteristics and properties of angles, triangles, parallelograms and circles to develop arguments about their geometric relationships. 2. Solve problems involving coordinate geometry, plane analytical geometry and vectors. 3. Recognize trigonometric identities, analyze conic sections, draw and interpret graphs of functions.	**Benchmark I:** Students will be able to interpret and solve plane analytical geometry problem situations **Benchmark II:** Students will be able to Identify vectors in space and apply vector addition, dot/ cross product, scalar product, differentiate and integrate vector functions. **Benchmark III:** Students will be able to Identify and analyse conic sections (circle, parabola, ellipse and hyperbola) and solve related problems. **Benchmark IV:** Students will be able to apply trigonometric identities and formulas to solve relevant situations and draw graphs of trigonometric and inverse trigonometric functions.	**Concurrency of Straight lines**	[SLO: M-12-B-03]		Show that • three right bisectors, • three medians, • three altitudes of a triangle are concurrent.	M	Matched SLO		Understand
			Area of a Triangular Region	[SLO: M-12-B-04]		Find the area of a triangular region whose vertices are given.	M	Matched SLO		Apply
			Homogeneous Equations	[SLO: M-12-B-05]	understand	Recognize homogeneous linear and quadratic equations in two variables.	m	Matched SLO	**Not assessable in summative**	Remember
				[SLO: M-12-B-06]		Investigate that the 2nd degree homogeneous equation in two variables represents a pair of straight lines through the origin and finds an acute angle between them.	R	Matched SLO		Apply
				[SLO: M-12-B-07]		Apply concepts of analytical geometry to real life world problems (such as aviation, to track stars, distance between planets and satellites, space science and engineering).	n	New SLO		Apply
			Vector Valued Function	[SLO: M-12-B-08]		Explain the need for a vector valued function.	m	New SLO	**Not assessable in summative**	Understand
				[SLO: M-12-B-09]		Construct vector valued function.	R	New SLO		Apply
				[SLO: M-12-B-10]		Identify domain and range of vector valued functions.	n	New SLO		Remember
				[SLO: M-12-B-11]		Identify difference between scalar and vector valued functions	n	New SLO		Remember
				[SLO: M-12-B-12]		Explain derivative of a vector function of a single variable and elaborate the result: If $f(t)=f_1(t)i+f_2(t)j+f_3(t)k$ Where $f_1(t)$, $f_2(t)$, $f_3(t)$ are differentiable functions of a scalar variable "t", then $df/dt=(df_1)/dt\ i+(df_2)/dt\ j+(df_3)/dt\ k$	n	Matched SLO	**Not assessable in summative**	Understand
				[SLO: M-12-B-13]		Apply vector differentiation to calculate velocity and acceleration of a position vector $f(t)=x(t)i+y(t)j+z(t)k$	n	Matched SLO		Apply
				[SLO: M-12-B-14]		Apply concepts of vector valued functions to real life word problems (such as engineering and transportation).	n	New SLO		Apply
			Inverse Trigonometric Functions	[SLO: M-12-B-15]		Find domains and ranges of principal trigonometric functions, inverse trigonometric functions.	n	Grade 11 SLO		Apply
			Graph of Inverse Trigonometric Functions	[SLO: M-12-B-16]	apply	Draw the graphs of the inverse trigonometric functions of cosine, sine, tangent, secant, cosecant and cotangent within the domain from -2π to 2π.	m	Grade 11 SLO		Create
			Inverse trigonometric identities and solution of trigonometric equations	[SLO: M-12-B-17]	understand, apply and analysis	State, prove and apply the addition and subtraction formulae of inverse trigonometric functions	n	Grade 11 SLO		Apply
				[SLO: M-12-B-18]		Solve trigonometric equations of the type $\sin\theta = k$, $\cos\theta = k$ and $\tan\theta = k$, using periodic, even/odd and translation properties.	n	Grade 11 SLO		Apply
				[SLO: M-12-B-19]		Solve graphically the trigonometric equations of the type: $\sin\frac{\theta}{2}=\theta/2$, $\cos\frac{\theta}{2}=\theta$, $\tan\frac{\theta}{2}=2\theta$, where $-\pi/2<\theta<\pi/2$	m	Grade 11 SLO		Apply
				[SLO: M-12-B-20]		Use the periods of trigonometric functions to find the general solution of the trigonometric equations.	m	Grade 11 SLO		Apply
				[SLO: M-12-B-21]		Apply concepts of inverse trigonometric functions to real lifeworld problems (such as mechanical engineering, architecture to find the height of the building, angle of elevation and depression, identifying the angle of bridges to build scale models).	m	New SLO		Apply
			Conics	[SLO: M-12-B-22]		Demonstrate conics and members of its family i.e. circle, parabola, ellipse and hyperbola.	m	Matched SLO		Understand
			Circle, Equation of a Circle	[SLO: M-12-B-23]	evaluate and apply	Derive and apply equation of a circle in standard form i.e. $(x-h)^2+(y-k)^2=r^2$	m	Matched SLO		Apply
				[SLO: M-12-B-24]		Find the equation of a circle passing through: three non collinear points, two points and having its centre on a given line, two points and equation of tangent at one of these points is known, two points and touching a given line.	n	Matched SLO		Apply
			Tangent and Normal	[SLO: M-12-B-25]		Find the condition when: a line intersects the circle. a line touches the circle.	m	Modified(rephrased) SLO		Apply
				[SLO: M-12-B-26]		Find the equation of a tangent to a circle in slope form and a normal to a circle at a point.	n	Modified(rephrased) SLO		Apply
				[SLO: M-12-B-27]		Find the length of tangent to a circle from a given external point.	n	Matched SLO		Apply
			Parabola	[SLO: M-12-B-28]	evaluate and apply	Derive and apply the standard equation of a parabola.	n	Modified (Split) SLO		Apply
				[SLO: M-12-B-29]		Sketch their graphs and find their elements.	n	Modified (Split) SLO		Apply
				[SLO: M-12-B-30]		Find the equation of a parabola with the following given elements: focus and vertex, focus and directrix, vertex and directrix.	m	Matched SLO		Apply
			Equations of Tangent and Normal	[SLO: M-12-B-31]		Find the condition when a line is tangent to a parabola at a point and hence write the equation of a tangent line in slope form.	m	Matched SLO		Apply
				[SLO: M-12-B-32]		Find the equation of a tangent and a normal to a parabola at a point.	n	Matched SLO		Apply
			Ellipse	[SLO: M-12-B-33]		Derive and apply the standard form of equation of an ellipse and identify its elements.	n	Matched SLO		Apply
				[SLO: M-12-B-34]		Convert a given equation to the standard form of equation of an ellipse, find its elements and draw the graph.	n	Matched SLO		Understand
			Equations of Tangent and Normal	[SLO: M-12-B -35]		Find point of intersection of an ellipse with a line including the condition of tangency.	n	Matched SLO		Apply
				[SLO: M-12-B -36]		Find the equation of a tangent to an ellipse in slope form.	n	Matched SLO		Apply
				[SLO: M-12-B -37]		Find the equation of a tangent and a normal to an ellipse at a point.	N	Matched SLO		Apply
			Standard Form of Equation of Hyperbola	[SLO: M-12-B -38]		Derive and apply the standard form of equation of a hyperbola and identify its elements.	n	Matched SLO		Apply
				[SLO: M-12-B -39]		Find the equation of a hyperbola with the following given elements: transverse and conjugate axes with centre at origin, two points, eccentricity, latera recta and transverse axes, focus, eccentricity and centre, focus, centre and directrix.	n	Matched SLO		Apply
			Equations of Tangent and Normal	[SLO: M-12-B-40]		Find points of intersection of hyperbola with a line including the condition of tangency.	m	Modified (Split) SLO		Apply
				[SLO: M-12-B-41]		Find the equation of a tangent to a hyperbola in slope form.	n	Modified (Split) SLO		Apply
				[SLO: M-12-B-42]		Find the equation of a tangent and a normal to a hyperbola at a point.		Matched SLO		Apply
				[SLO: M-12-B-43]		Apply concepts of conics to real life world problems (such as suspension and reflection problems related to parabola, Satellite system, elliptic movement of electrons in the atom around the nucleus, radio system use as hyperbolic functions, flashlights, conics in architecture).	n	New SLO		Apply