Mathematics
GRADE 11

Domains	Standards	Benchmarks	Topic/Title	NC SLO #		NCP (2022) - SLO	Cognitive Domain
			Complex Number	[SLO: M-11-A-01]		Recall complex number z represented by an expression of the form z = a + ib or of the form (a, b) where a and b are real numbers and $i = \sqrt{-1}$	Remember
				[SLO: M-11-A-02]		Recognize **a** as a real part of z and **b** as an imaginary part of z.	Understand
				[SLO: M-11-A-03]		Know the condition for equality of complex numbers.	Understand
				[SLO: M-11-A-04]		Carry out basic operations on complex numbers	Apply
				[SLO: M-11-A-05]		Define z = a - ib as the complex conjugate of z = a + ib.	Remember
				[SLO:M-11-A-06]		Define $|z| = \sqrt{a^2+b^2}$) as the absolute value or modulus of a complex number z = a + ib	Remember
		Benchmark I: Students will be able to Identify complex numbers and their properties to carry out basic operations.	Solution of Equations	[SLO: M-11-A-07]		i) Solve the simultaneous linear equations with complex coefficients. For example,	Apply
				[SLO: M-11-A-08]		Write the polynomial P(z) as a product of linear factors. For example, z^2+ a^2=(z+ia)(z-ia) z^3-3z^2 + z +5 = (z+1)(z-2-i)(z-2+i) $\begin{cases} 5z-(3+i)w = 7-i, \\ (2-i)z + 2iw = -1+i. \end{cases}$	Understand
				[SLO: M-11-A-09]		Solve quadratic equation of the form 2 pz + qz + r = 0 by completing squares, where p, q, r are real numbers and z a complex number. For example Solve: z^2-2z+5=0 (z − 1 − 2i)(z − 1 +2i) =0 z = 1 + 2i,1 − 2i	Apply
				[SLO: M-11-A-10]		Explain the polar coordinates system.	Understand
				[SLO: M-11-A-11]		Describe the polar representation of a complex number.	Understand
				[SLO: M-11-A-12]		Apply the operations with complex numbers in polar representation.	Apply
				[SLO: M-11-A-13]		Demonstrate simple equations and in-equations involving complex numbers in polar form.	Apply
				[SLO: M-11-A-14]		Apply concepts of complex numbers to real world problems (such as cryptography, wave phenomena, calculate voltage, current, circuits, the velocity and pressure of the fluid).	Apply
				[SLO: M-11-A-15]		Apply matrix operations (addition/subtraction and multiplication of matrices) with real and complex entries.	Apply

Domain	Standard	Benchmark	Topic	SLO		Description	Cognitive Level
Numbers and Algebra	Compare the properties of numbers and number systems, including the rational and real numbers, and understand complex numbers as solutions to quadratic equations that do not have real solutions. 1.Understand vectors and matrices as systems that have some of the properties of the real number system. 1.Analyse and interpret mathematical situations by manipulating algebraic expressions and relations,	**Benchmark II:** Students will be able to perform matrix algebra, evaluate determinant and solve homogeneous and non-homogeneous linear equations.,	**Matrices & Determinants**	[SLO: M-11-A-16]	Analysis	Evaluate determinants of 3 x 3 matrix by using cofactors and properties of determinants.	Evaluate
				[SLO: M-11-A-17]		Use row operations to find the inverse and the rank of a matrix.	Apply
				[SLO: M-11-A-18]		Explain a consistent and inconsistent system of linear equations and demonstrate through examples	Understand
				[SLO: M-11-A-19]		Solve a system of 3 by 3 nonhomogeneous linear equations by using matrix inversion method and Cramer's Rule.	Apply
				[SLO: M-11-A-20]		Solve a system of three homogeneous linear equations in three unknowns using the Gaussian elimination method.	Apply
				[SLO: M-11-A-21]		Apply concepts of matrices to real world problems such as (graphic design, data encryption, seismic analysis, cryptography, transformation of geometric shapes, social network analysis).	Apply
		Benchmark III: Students will be able to demonstrate Arithmetic, geometric and harmonic sequence, their means and sum of series and apply them in real world problems.	**Arithmetic Sequence And Series**	[SLO: M-11-A-22]		Solve problems by analysing arithmetic sequences and series up to n terms.	Apply
			Geometric Sequence and Mean	[SLO: M-11-A-23]		Solve problems by analysing geometric sequences and series up to n terms.	Apply
				[SLO: M-11-A-24]		Identify a sequence as arithmetic or geometric sequence up to n terms.	Understand
				[SLO: M-11-A-25]		Solve problems by analysing harmonic sequences and series up to n terms.	Apply
			Miscellaneous Series	[SLO: M-11-A-26]	Application	Find sum of: • the first n natural numbers ($\sum$n), • the squares of the first n natural numbers ($\sum$ n2), • the cubes of the first n natural numbers ($\sum$ n3).	Apply
				[SLO: M-11-A-27]		Recognize the arithmetic geometric sequence, determine its general term, find sum to n terms and sum to infinite number of terms, using sigma notation.	Understand
				[SLO: M-11-A-28]		Identify leasing of motor vehicles, down payment, motor vehicle insurance, processing charges, repayment in monthly instalments.	Understand
				[SLO: M-11-A-29]		Solve problems related to leasing of motor vehicle under different conditions.	Apply
				[SLO: M-11-A-30]		Apply concepts from sequence and series to real world problems (such as simple interest on loan, investment, depreciation, Investment planning on compound interest, projectile motion, gaming strategy, health care management, web page design, traffic modelling).	Apply
		Benchmark IV: Students will be able to apply the principle of Mathematical Induction to prove statements, identities, and formulae, and find approximate values of the	**Mathematical Induction**	[SLO: M-11-A-31]		Describe a mathematical argument, identify the base case, induction of hypothesis and a precise conclusion.	Understand
				[SLO: M-11-A-32]		Apply the principle of mathematical induction to prove statements, identities, divisibility of numbers and summation formulae.	Apply
				[SLO: M-11-A-33]		Evaluate and justify conclusions, communicating a position clearly in an appropriate mathematical form in daily life	Evaluate
				[SLO: M-11-A-34]		State and apply the Binomial Theorem to expand expressions of the form $(a + b)^n$ where n is a positive integer.	Apply
				[SLO: M-11-A-35]		Describe Binomial Theorem as expansion of binomial powers restricted to the set of natural numbers.	Understand
				[SLO: M-11-A-36]		Calculate binomial coefficients using Pascal's triangle.	Apply
				[SLO: M-11-A-37]		Expand using the binomial theorems, and use appropriate techniques to simplify the expression	Apply

			Binomial Theorem	[SLO: M-11-A-38]	apply	Find an approximate value using binomial theorem Applications of Binomial Theorem	Apply
		approximate values of the binomial expansions having indices as rational numbers.		[SLO: M-11-A-39]		Use binomial theorem to find the remainder when a number to some large exponent is divided by a number.	Apply
				[SLO: M-11-A-40]		Use binomial theorem to find the last digit of a number, test the divisibility by a number and compare two large numbers.	Apply
				[SLO: M-11-A-41]		Apply concepts of Mathematical induction and binomial theorem to real world problems such as (puzzles, domino effects, Pascal's triangle, Economic forecasting, Rankings, Variable subletting)	Apply
		Benchmark V: Students will be able to divide polynomials, apply factor theorem, remainder theorem, factorise cubic polynomial and resolve an algebraic fraction into partial fractions	**Divide of polynomial**	[SLO: M-11-A-42]	Apply	Divide a polynomial of degree up to 4 by a linear and quadratic polynomial to identify quotient and remainder. Remainder Theorem and Factor Theorem:	Understand
				[SLO: M-11-A-43]		Demonstrate and apply remainder theorem	Apply
				[SLO: M-11-A-44]		Analyse and apply factor theorem to factorise a cubic polynomial	Apply
				[SLO: M-11-A-45]		Apply concepts of remainder and factor theorem to real world problems (such as polynomial regression, signal processing, and coding theory).	Apply
Geometry	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.	**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.	**Vectors in Space**	[SLO: M-11-B-01]		Recognize rectangular coordinate system in space.	Understand
				[SLO: M-11-B-02]		Recognize: unit vectors z. ,z and z. components of a vector.	Understand
				[SLO: M-11-B-03]		Find the magnitude of a vector.	Apply
				[SLO: M-11-B-04]		Repeat all fundamental mathematical operations for vectors in space which, in the plane, have already been discussed.	Remember
				[SLO: M-11-B-05]		Demonstrate and prove properties of Vector Addition • Commutative law for vector addition. • Associative law for vector addition. • 0 as the identity for vector addition. • − z̄ as the inverse for z̄. • Dot or Scalar Product	Apply
				[SLO: M-11-B-06]		Explain dot or scalar product of two vectors and give its geometrical interpretation.	Apply
				[SLO: M-11-B-07]		Express dot product in terms of components.	Understand
				[SLO: M-11-B-08]		Find the condition for orthogonality of two vectors.	Understand
				[SLO: M-11-B-09]		Use dot product to find the angle between two vectors.	Apply
				[SLO: M-11-B-10]		Find the projection of a vector along another vector.	Apply
				[SLO: M-11-B-11]		Find the work done by a constant force in moving an object along a given vector.	Apply
				[SLO: M-11-B-12]		Solve daily life problems based on vectors. Cross or Vector Product	Apply
				[SLO: M-11-B-13]		Explain the cross or vector product of two vectors and give its geometrical interpretation.	Understand
				[SLO: M-11-B-14]		Apply a cross product to find the angle between two vectors.	Apply
				[SLO: M-11-B-15]		Solve situations in daily life based on Cross or dot Vector Product.	Apply
			Scalar Triple Product	[SLO: M-11-B-16]		Describe scalar triple product of vectors.	Understand
				[SLO: M-11-B-17]		Express scalar triple product of vectors in terms of components (determinant form).	Understand
				[SLO: M-11-B18]		Prove that: • i . j × k = j . k × i = k . i × j =1, • i .·k × j = j .·i ×k = k .· j ×i = −1 Prove that dot and cross are inter-changeable in scalar triple product.	Analyse
				[SLO: M-11-B-19]		Find the volume of • a parallelepiped, • tetrahedron, determined by three given vectors	Apply
				[SLO: M-11-B-20]		Define coplanar vectors and find the condition for planarity of three vectors.	Remember
				[SLO: M-11-B-21]		Apply concepts of vectors in space to real world problems such as (design and execute optimal navigation paths in transportation and logistics, graphing complex 3D motion, vector operations in engineering and computer graphics, practical proficiency for work, flux, and circulation).	Apply

				[SLO: M-11-B -22]	should not be assessed	Establish fundamental law of trigonometry:	Understand
	1.Recognize trigonometric identities, analyze conic sections, draw and interpret graphs of functions.	**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.	**Fundamental Law of Trigonometry**	[SLO: M-11-B -23]		Apply fundamental law and its deductions to derive: Trigonometric ratios of allied angles, double angle, half angle and triple angle identities	Apply
				[SLO: M-11-B -24]		Express the product (of sines and cosines) as sums or differences (of sines and cosines).	Understand
			Trigonometric Functions	[SLO: M-11-B -25]		Find the domain and range of the trigonometric functions	Understand
				[SLO: M-11-B -26]		Discuss even, odd functions and the periodicity of trigonometric functions	Understand
				[SLO: M-11-B -27]		Find the maximum and minimum value of a given function of the type $a+b \sin\theta$, $a+b \cos\theta$, $a+b \sin((c\theta)+d)$, $a+b \cos((c\theta)+d)$ the reciprocals of above, where a, b, c and d are real numbers.	Understand
			Graphs of Trigonometric Functions	[SLO: M-11-B-28]		Graph and analyse the trigonometric functions sine, cosine, and tangent to solve problems,	Analyse
				[SLO: M-11-B -29]		Explain the properties of graphs of $\sin\theta$, $\cos\theta$ and $\tan\theta$	Understand
				[SLO: M-11-B-30]		Apply the concepts of trigonometric functions, identities, graphs, periodicity, even odd functions, extreme values to real world problems such as (distance, elevation, and direction of tall structures, navigation and mapping, lengths of irregular shapes, graphs to visualize and predict patterns in data, frequency and periodic length of Ferris wheel, forces on a see-saw or lever, the ideal angle for solar panel placement).	Apply
Information Handling	The students will be able to collect, organize, analyse, display and interpret data/ information.	**Benchmark I**: Students will be able to solve problems involving permutations and combinations	**Permutation and Combination**	[SLO: M-11-C-01]		Explain and solve problems that involve the fundamental counting principle.	Understand
				[SLO: M-11-C-02]		Explain and Solve problems that involve permutations.	Understand
				[SLO: M-11-C-03]		Explain and Solve problems that involve combinations.	Understand
				[SLO: M-11-C -04]		Apply the concepts of permutation and combination to real world problems such as (cryptography, estimating the odds of winning a lottery, calculating the number of possible DNA sequences or protein structures, choosing different sets of songs for certain occasions)	Apply