

GENERAL CERTIFICATE OF EDUCATION

ADVANCED LEVEL

(Grade 12 and 13)

MATHEMATICS

SYLLABUS

(Effective from 2017)



Department of Mathematics
Faculty of Science and Technology
National Institute of Education
Maharagama
SRI LANKA

Mathematics
Grade 12 and 13 - syllabus

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1.0 Introduction

The aim of education is to turn out creative children who would suit the modern world. To achieve this, the school curriculum should be revised according to the needs of the time.

Thus, it had been decided to introduce a competency based syllabus in 2009. The earlier revision of the G.C.E (Advanced Level) Mathematics syllabus was conducted in 1998. One of the main reasons for the need to revise the earlier syllabus had been the Learning-Teaching-Assessment process, competencies and competency levels had not been introduced adequately. It has been planned to change the existing syllabus that had been designed on a content based approach to a competency based curriculum in 2009. In 2007, the curriculum revision which started at Grades 6 and 10 had introduced a competency based **syllabi** to Mathematics. This was continued at Grades 7 and 11 in 2008 and it will be continued to Grades 8 and 12 in 2009. Thus, a need has arisen to provide a competency based syllabus for mathematics at G.C.E. (Advanced Level) to those pupils who have followed a competency based syllabus at Grades 10 and 11.

The arrival of the computer on the national scene and the increasing use of mathematical techniques in the Biological Science and Social Sciences have brought about a new situation requiring the teaching of such techniques at the G.C.E. (Advanced Level).

In order to cater to the above situation a third subject called "Mathematics" was introduced in 1998 for the first time.

Now this subject "Mathematics" is revised and rearranged in a way so that Mathematics I contains Pure Mathematics Components and Mathematics II contains Probability and Statistics Components.

The subject may not be offered by students taking Combined Mathematics or Higher Mathematics at the G.C.E. (Advanced Level).

After implementing the Combined Mathematics syllabus in 2009 it was revisited in the year 2012. In the following years teachers' views and experts' opinion about the syllabus, was obtained and formed a subject committee for the revision of the Combined Mathematics syllabus by accommodating above opinions the committee made the necessary changes and revised the syllabus to implement in the year 2017.

2.0 Common National Goals

The national system of education should assist individuals and groups to achieve major national goals that are relevant to the individual and society. Over the years major education reports and documents in Sri Lanka have set goals that sought to meet individual and national needs. In the light of the weaknesses manifest in contemporary educational structures and processes, the National Education Commission has identified the following set of goals to be achieved through education within the conceptual framework of sustainable human development.

- I Nation building and the establishment of a Sri Lankan identity through the promotion of national cohesion, national integrity, national unity, harmony and peace, and recognizing cultural diversity in Sri Lanka's plural society within a concept of respect for human dignity.
- II Recognizing and conserving the best elements of the nation's heritage while responding to the challenges of a changing world.
- III Creating and supporting an environment imbued with the norms of social justice and a democratic way of life that promotes respect for human rights, awareness of duties and obligations, and a deep and abiding concern for one another.
- IV Promoting the mental and physical well-being of individuals and a sustainable life style based on respect for human values.
- V Developing creativity, initiative, critical thinking, responsibility, accountability and other positive elements of a well-integrated and balance personality.
- VI Human resource development by educating for productive work that enhances the quality of life of the individual and the nation and contributes to the economic development of Sri Lanka.
- VII Preparing individuals to adapt to and manage change, and to develop capacity to cope with complex and unforeseen situations in a rapidly changing world.
- VIII Fostering attitudes and skills that will contribute to securing an honourable place in the international community, based on justice, equality and mutual respect.

3.0 Basic Competencies

The following Basic Competencies developed through education will contribute to achieving the above National Goals.

(i) Competencies in Communication

Competencies in Communication are based on four subjects: Literacy, Numeracy, Graphics and IT proficiency.

Literacy : Listen attentively, speak clearly, read for meaning, write accurately and lucidly and communicate ideas effectively.

Numeracy : Use numbers for things, space and time, count, calculate and measure systematically.

Graphics : Make sense of line and form, express and record details, instructions and ideas with line form and color.

IT proficiency : Computeracy and the use of information and communication technologies (ICT) in learning, in the work environment and in personal life.

(ii) Competencies relating to Personality Development

- General skills such as creativity, divergent thinking, initiative, decision making, problem solving, critical and analytical thinking, team work, inter-personal relations, discovering and exploring;
- Values such as integrity, tolerance and respect for human dignity;
- Emotional intelligence.

(iii) Competencies relating to the Environment

These competencies relate to the environment : social, biological and physical.

Social Environment : Awareness of the national heritage, sensitivity and skills linked to being members of a plural society, concern for distributive justice, social relationships, personal conduct, general and legal conventions, rights, responsibilities, duties and obligations.

Biological Environment : Awareness, sensitivity and skills linked to the living world, people and the ecosystem, the trees, forests, seas, water, air and life-plant, animal and human life.

Physical Environment : Awareness, sensitivity and skills linked to space, energy, fuels, matter, materials and their links with human living, food, clothing, shelter, health, comfort, respiration, sleep, relaxation, rest, wastes and excretion.

Included here are skills in using tools and technologies for learning, working and living.

(iv) Competencies relating to Preparation for the World of Work.

Employment related skills to maximize their potential and to enhance their capacity to contribute to economic development,
to discover their vocational interests and aptitudes,
to choose a job that suits their abilities, and
to engage in a rewarding and sustainable livelihood.

(v) Competencies relating to Religion and Ethics

Assimilating and internalizing values, so that individuals may function in a manner consistent with the ethical, moral and religious modes of conduct in everyday living, selecting that which is most appropriate.

(vi) Competencies in Play and the Use of Leisure

Pleasure, joy, emotions and such human experiences as expressed through aesthetics, literature, play, sports and athletics, leisure pursuits and other creative modes of living.

(vii) Competencies relating to ‘learning to learn’

Empowering individuals to learn independently and to be sensitive and successful in responding to and managing change through a transformative process, in a rapidly changing, complex and interdependent world.

4.0 Aims of the Syllabus

- (i) To provide basic skills of mathematics to continue higher studies in mathematics.
- (ii) To provide the students experience on strategies of solving mathematical problems.
- (iii) To improve the students knowledge of logical thinking in mathematics.
- (iv) To motivate the students to learn mathematics.

This syllabus was prepared to achieve the above objectives through learning mathematics. It is expected not only to improve the knowledge of mathematics but also to improve the skill of applying the knowledge of mathematics in their day to day life and character development through this new syllabus.

When we implement this competency Based Syllabus in the learning - teaching process.

- Meaningful Discovery situations provided would lead to learning that would be more student centred.
- It will provide competencies according to the level of the students.
- Teacher's targets will be more specific.
- Teacher can provide necessary feed back as he/she is able to identify the student's levels of achieving each competency level.
- Teacher can play a transformation role by being away from other traditional teaching methods.

When this syllabus is implemented in the classroom the teacher should be able to create new teaching techniques by relating to various situations under given topics according to the current needs.

For the teachers it would be easy to assess and evaluate the achievement levels of students as it will facilitate to do activities on each competency level in the learning- teaching process.

In this syllabus, the sections given below are helpful in the teaching - learning process of Combined Mathematics.

5.0 Relationship between the Common National Goals and the Competencies of the Syllabus.

Competencies of the Syllabus - Mathematics I	Common National Goals						
	i	ii	iii	iv	v	vi	vi
1. Analyses the Real Number system	✓	✓	✓	✓	✓	✓	✓
2. Manipulates Algebra of Sets	✓	✓	✓	✓	✓	✓	✓
3. Manipulates Mathematical Logic	✓	✓	✓	✓	✓	✓	✓
4. Manipulates the methods of proofs to prove the mathematical results	✓	✓	✓	✓	✓	✓	✓
5. Analyses functions of a real variable	✓	✓	✓	✓	✓	✓	✓
6. Analyses polynomials	✓	✓	✓	✓	✓	✓	✓
7. Investigates rational functions	✓	✓	✓	✓	✓	✓	✓
8. Manipulates inequalities.	✓	✓	✓	✓	✓	✓	✓
9. Explores the binomial expansion for positive integral indices.	✓	✓	✓	✓	✓	✓	✓
10. Finds the sum of the finite series	✓	✓	✓	✓	✓	✓	✓
11. Determines the limit of the function	✓	✓	✓	✓	✓	✓	✓
12. Investigates straight lines in terms of cartesian co-ordinates	✓	✓	✓	✓	✓	✓	✓
13. Uses the derivatives of a function to solve problems.	✓	✓	✓	✓	✓	✓	✓
14. Finds indefinite and definite integrals of functions	✓	✓	✓	✓	✓	✓	✓

5.0 Relationship between the Common National Goals and the Competencies of the Syllabus.

Competencies of the Syllabus - Mathematics II	Common National Goals						
	i	ii	iii	iv	v	vi	vi
1. Interprets the basics of statistics	✓	✓	✓	✓	✓	✓	✓
2. Presents data and information systematically	✓	✓	✓	✓	✓	✓	✓
3. Interprets the behaviour of a frequency distribution	✓	✓	✓	✓	✓	✓	✓
4. Analyses random phenomena mathematically	✓	✓	✓	✓	✓	✓	✓
5. Determines the optimum solution of a linear programming problem	✓	✓	✓	✓	✓	✓	✓
6. Uses Permutation and combination to solve Mathematical problems	✓	✓	✓	✓	✓	✓	✓
7. Analyses projects by using networks	✓	✓	✓	✓	✓	✓	✓
8. Manipulates Determinants as a mathematical model of solving problems	✓	✓	✓	✓	✓	✓	✓
9. Manipulates Matrix Algebra	✓	✓	✓	✓	✓	✓	✓

Gradr 12		
Subject	Number of Periods	Total
First Term		
Mathematics I	94	110
Mathematics II	16	
Second Term		
Mathematics I	72	96
Mathematics II	24	
Third Term		
Mathematics I	32	97
Mathematics II	65	
Gradr 13		
First Term		
Mathematics I	40	106
Mathematics II	66	
Second Term		
Mathematics I	40	109
Mathematics II	69	
Third Term		
Mathematics I	42	82
Mathematics II	40	

**6.0 Proposed Term Wise Breakdown of the Syllabus
Grade - 12**

Competency Level	Content	Number of Periods
Term I		
Mathematics -I		
1.1, 1.2,1.3	<ul style="list-style-type: none"> • Real number system 	14
2.1,2.2	<ul style="list-style-type: none"> • Algebra of sets 	12
3.1	<ul style="list-style-type: none"> • Mathematical logic 	10
5.1, 5.2	<ul style="list-style-type: none"> • One variable functions 	20
6.1, 6.2, 6.3, 6.4	<ul style="list-style-type: none"> • Polynomials 	38
Mathematics -II		
1.1, 1.2	<ul style="list-style-type: none"> • Basics of Statistics 	06
2.1, 2.2,2.3,2.4	<ul style="list-style-type: none"> • Data,data representation 	10
Term II		
Mathematics -I		
12.1, 12.2, 12.3, 12.4,12.5	<ul style="list-style-type: none"> • Straight lines 	30
7.1, 7.2	<ul style="list-style-type: none"> • Rational functions and logarithm 	30
4.1	<ul style="list-style-type: none"> • Methods of proofs 	12
Mathematics -II		
3.1,3.2	<ul style="list-style-type: none"> • Measures of central tendency 	24
Term III		
Mathematics -I		
8.1, 8.2, 8.3	<ul style="list-style-type: none"> • Inequalities 	24
11.1	<ul style="list-style-type: none"> • Limits 	08
Mathematics -II		
3.3, 3.4,3.5, 3.6, 3.7	<ul style="list-style-type: none"> • Frequency distribution 	23
4.1, 4.2	<ul style="list-style-type: none"> • Random experiments and probability 	18
6.1, 6.2	<ul style="list-style-type: none"> • Permutation and combination 	24

6.0 Proposed Termwise breakdown of the syllabus - Grade - 13

Competency Level	Content	No. of Periods
Term I		
Mathematics -I		
13.3, 13.4,13.5,13.6, 13.7	<ul style="list-style-type: none"> • Derivatives 	40
Mathematics -II		
4.3, 4.4,4.5, 4.6, 4.7,4.8.4.9	<ul style="list-style-type: none"> • Probability 	66
Term II		
Mathematics -I		
14.1, 14.2, 14.3, 14.4, 14.5,14.6.	<ul style="list-style-type: none"> • Integration 	
14.7		40
Mathematics -II		
4.10	<ul style="list-style-type: none"> • Discrete probability distribution 	14
5.1, 5.2	<ul style="list-style-type: none"> • Linear programming 	25
8.1,8.2	<ul style="list-style-type: none"> • Determinants 	10
9.1, 9.2	<ul style="list-style-type: none"> • Matrices 	20
Term III		
Mathematics -I		
9.1, 9.2	<ul style="list-style-type: none"> • Binomial expansion 	16
10.1, 10.2, 10.3	<ul style="list-style-type: none"> • Series 	26
Mathematics -II		
4.11	<ul style="list-style-type: none"> • Continuous probability distribution 	15
7.1,7.2	<ul style="list-style-type: none"> • Networks 	25

**7.0 Syllabus
Mathematics - I**

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
1. Analyses the Real Number system	1.1 Classifies the Real number system	<ul style="list-style-type: none"> • Review of the real number system • Notations for sets of numbers • Geometrical representation of a real number 	<ul style="list-style-type: none"> • Writes correct notations for sets of numbers • Represents real numbers geometrically 	04
	1.2 Uses surds and decimals to represents real numbers	<ul style="list-style-type: none"> • Decimal representation of a real number <ul style="list-style-type: none"> ◊ Finite decimals ◊ Infinite decimals ◊ Recurring decimals • Surds and expressions involving surds 	<ul style="list-style-type: none"> • Classifies decimal numbers • Classifies real numbers • Rationalises the denominator of expressions with surds • Uses arithmetical operation on surds 	04
	1.3 Uses Exponents (indices) and radicals to communicate real numbers	<ul style="list-style-type: none"> • Positive integral Exponents (indices) • Negative integral and zero exponents • Fractional exponents 	<ul style="list-style-type: none"> • Defines indicies. • States laws of indices • Classifies positive integral exponents, negative integral exponents, zero exponents and fractinal exponents • Applies laws of indicies to various problems 	06

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
2. Manipulates Algebra of Sets	2.1 Applies basics of sets to solve problems	<ul style="list-style-type: none"> Language of sets and elements of a set <ul style="list-style-type: none"> Universal set, null set, finite set and infinite set and Cardinality of a set Subsets, proper subsets, equality of two sets, and Power set 	<ul style="list-style-type: none"> Explains set notations Explains and writes the notations of universal set and null set Explains finite sets and infinite sets Defines, Cardinality of set & writes its notation Defines subsets, proper sub sets equality of two sets and power set 	06
	2.2 Uses Venn diagrams and algebra of sets to solve problems	<ul style="list-style-type: none"> Set operations <ul style="list-style-type: none"> Intersection and union Complement, relative complement Set identities The formula $n(A \cup B) = n(A) + n(B) - n(A \cap B)$ 	<ul style="list-style-type: none"> States the set operations also with venn diagrams Writes the formula of set identities Solves problems involving set identities 	06
3. Manipulates Mathematical Logic	3.1 Identify statements	<ul style="list-style-type: none"> Statements Logical connectives and compound statements Conditional statements Compound statements Construction of the truth table Logical equivalents Predicates Quantifiers <ul style="list-style-type: none"> Symbolization of Predicates 	<ul style="list-style-type: none"> Identifies statements Identifies the different types of statements Writes the definition of all types of statements Constructs of truth tables Defines conditional statements Defines compound statements States the definitions of logical equivalents and predicates of an event Defines Quantifiers Writes the Symbolization of Predicates 	10

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
4. Manipulates the methods of proofs to prove the mathematical results	4.1 Proves Mathematical results by using direct proof, proof by contradiction and proof by mathematical induction	<ul style="list-style-type: none"> • Methods of proof <ul style="list-style-type: none"> • Direct proof • Proof by contradiction • Proof by Mathematical induction 	<ul style="list-style-type: none"> • States methods of proofs • Describes direct proof, proof by contradiction and proof by mathematical induction • Solves problems involving different types of proofs 	12
5. Analyses functions of a real variable	5.1 Investigates functions	<ul style="list-style-type: none"> • Definition of a function as one-one or many-one relation <ul style="list-style-type: none"> • Domain, range • Graph of a function, vertical line test for a function • Elementry functions $f(x) = ax + b$, $f(x) = x$, $f(x) = x^2$, $f(x) = \frac{1}{x}$, ($x \neq 0$) $f(x) = \sqrt{x}$, $x \geq 0$, $f(x) = \frac{1}{x^2}$ ($x \neq 0$) • Graphing functions using translations (shifting) 	<ul style="list-style-type: none"> • Explains the definition of a function • Sketch graphs • Explains domain and range of a function • Describes vertical line test for a function • Recognizes special functions • Sketches graphs of special functions • Sketches functions using translations (shifting) 	10

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
	5.2 Investigates operations on functions	<ul style="list-style-type: none"> • Basic operation $+$, $-$, \times, and \div • Composite functions • Inverse functions <ul style="list-style-type: none"> • Definition of inverse function • Finding the inverse function 	<ul style="list-style-type: none"> • Performs basic operations on functions • Defines composite functions • Writes the notations for composite functions • Defines inverse function • Finds the inverse functions 	10
6. Analyses polynomials	6.1 Investigates polynomials	<ul style="list-style-type: none"> • Polynomials in one variable <ul style="list-style-type: none"> • Degree, leading term and leading coefficient • Equality of two polynomials 	<ul style="list-style-type: none"> • Defines a polynomial in a single variable • Defines the terms degree, leading term and leading coefficient. • States the condition for two polynomials to be equal 	02
	6.2 Uses mathematical operation involving polynomials	<ul style="list-style-type: none"> • Mathematical operations involving polynomials <ul style="list-style-type: none"> • Addition, subtraction • Multiplication • Division, long division • Synthetic division by a linear expression • Remainder theorem • Factor theorem 	<ul style="list-style-type: none"> • Manipulates the basic mathematical operations on polynomials • Divides a polynomial by another polynomial • States synthetic division • States the remainder theorem • Proves the remainder theorem • States the factor theorem • Proves the factor theorem • Expresses converse of the factor theorem • Solves the problems using remainder theorem and factor theorem. • Solves the polynomial equations (up to 4th order) • Defines zeros of a polynomial 	10

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
	6.3 Investigates quadratic functions and their properties	<ul style="list-style-type: none"> • Quadratic functions <ul style="list-style-type: none"> • Completing the square • Discriminant • Least value and greatest value • Sketching the graph • Applications of quadratic functions 	<ul style="list-style-type: none"> • Introduces linear functions • Explains quadratic functions • Explains the properties of a quadratic function • Sketches the graph of a quadratic function • Describes different types of graph of quadratic functions • Solves problems involving quadratic functions. 	10
	6.4 Investigates quadratic equations	<ul style="list-style-type: none"> • Quadratic equation <ul style="list-style-type: none"> • Solution by completion of square • Graphical solution • Use of quadratic formula <ul style="list-style-type: none"> • Discriminant (Δ) • Analysis of roots <ul style="list-style-type: none"> • Real and distinct • Real and coincident • Not real • Solution of simultaneous equations, of one equation is linear in two variables and the other equation is quadratic in one or both variables 	<ul style="list-style-type: none"> • Explains the roots as α and β of a quadratic equation $ax^2 + bx + c = 0$ • Finds the roots of a quadratic equation • Describes the nature of the roots of a quadratic equation • Expresses the sum and products of the roots of quadratic equations in terms of its coefficients • Constructs quadratic equations where roots are symmetric functions of α and β • Solves problems involving quadratic functions and quadratic equations 	16

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
7. Investigates rational functions	7.1 Resolution of a rational function into partial fractions	<ul style="list-style-type: none"> • Rational functions <ul style="list-style-type: none"> • Proper rational functions • Improper rational functions • Partial fractions <ul style="list-style-type: none"> • Partial fractions of proper rational functions • Partial fractions of improper rational functions 	<ul style="list-style-type: none"> • Defines rational functions • Defines proper rational functions and improper rational functions • Finds partial fractions of proper rational functions • Finds partial fractions of improper rational functions. (not more than 4 unknowns are expected)	15
	7.2 Analyses the Exponential and Logarithmic functions	<ul style="list-style-type: none"> • Exponential function and its properties <ul style="list-style-type: none"> • Graphs of growth and decay of population • definition of e • Properties of e^x • Graph of e^x • Logarithmic function and its properties <ul style="list-style-type: none"> • Properties of $\ln x$ • Change of base • Graph of $\ln x$ • Examples on compound Interest, Population growth, radiation and pH values etc. 	<ul style="list-style-type: none"> • States the properties of exponential functions • Sketches graph of exponential functions • States the properties of e^x and draws its graph • States the properties of $\ln x$ • Writes change of base of a logarithmic function • Draws the graph of $\ln x$ • Compares the relations between $\ln x$ and e^x • Finds the compound Interest, population growth using proper equation. 	15

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
8.Manipulates inequalities.	8.1 Solves problems involving linear and quadratic inequalities	<ul style="list-style-type: none"> • Inequalities <ul style="list-style-type: none"> • Linear inequalities • Quadratic inequalities • Some by graph Simultaneous linear inequalities 	<ul style="list-style-type: none"> • Solves linear and quadratic inequalities • Solves Simultaneous linear inequalities 	10
	8.2 Solves quadratic inequalities using graphical method	<ul style="list-style-type: none"> • Quadratic inequalities using graphs 	<ul style="list-style-type: none"> • Solves quadratic inequalities using graphs 	06
	8.3 Solves inequalities involving rational functions.	<ul style="list-style-type: none"> • Inequalities of the form $\frac{P(x)}{Q(x)}$ where $f(x), g(x)$ are polynomials of x (degree ≤ 3) and $g(x) \neq 0$ 	<ul style="list-style-type: none"> • Solves in inequalities of the form $\frac{f(x)}{g(x)}$ where $f(x), g(x)$ are polynomials of x (degree ≤ 3) and $g(x) \neq 0$ (Graphical methods are not expected) 	08
9. Explores the binomial expansion for positive integral indices.	9.1 Describes the basic properties of the binomial expansion.	<ul style="list-style-type: none"> • Expansion of $(a + b)^n$ expressing the coefficients in the form ${}^n C_r$ • Applications of the expansion of $(a + b)^n$ 	<ul style="list-style-type: none"> • Defines ${}^n C_r$ and obtain the formula for it • Expands $(a + b)^n$ using binomial theorem <ul style="list-style-type: none"> • Writes the general term in the expansion of $(a + b)^n$ 	08
	9.2 Applies binomial theorem	<ul style="list-style-type: none"> • Expansion of $(1 + x)^n$ • Application of the expansion of $(1 + x)^n$ • Series 	<ul style="list-style-type: none"> • Expands $(1 + x)^n$ using binomial theorem <ul style="list-style-type: none"> • Writes the general term in the expansion of $(1 + x)^n$ • Solves problems involving binomial expansion 	08

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
10. Finds the sum of the finite series	10.1 Describes finite series and their properties.	<ul style="list-style-type: none"> Summation, General term 	<ul style="list-style-type: none"> Finds the sum of arithmetic and geometric series Finds the general term of arithmetic and geometric series. 	08
	10.2 Solves problems involving arithmetic and geometric series.	<ul style="list-style-type: none"> “Sigma” notation $\sum_{r=1}^n (kU_r) = k \sum_{r=1}^n U_r$ $\sum_{r=1}^n (U_r + V_r) = \sum_{r=1}^n U_r + \sum_{r=1}^n V_r$ 	<ul style="list-style-type: none"> Writes the series using Σ notation and find the sum Applications of arithmetic and geometric series by using sigma notation 	08
	10.3 Finds sums of elementary series	<ul style="list-style-type: none"> $\sum_{r=1}^n r, \sum_{r=1}^n r^2, \sum_{r=1}^n r^3$ and their applications 	<ul style="list-style-type: none"> Proves and uses the formulae by principal of Mathematical Induction for values $\sum_{r=1}^n r, \sum_{r=1}^n r^2, \sum_{r=1}^n r^3$ Applies the above formulae to find the summation of series 	10

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
the limit of the function	11.1 Interpretes the limit of a function. Solves problems using the theorems on limits. Uses the limit; $\lim_{x \rightarrow a} \left(\frac{x^n - a^n}{x - a} \right) = na^{n-1}$ to solve problems	<ul style="list-style-type: none"> • Intuitive idea of a limit • Theorems on limits • Proof of $\lim_{x \rightarrow a} \left(\frac{x^n - a^n}{x - a} \right) = na^{n-1}$ 	<ul style="list-style-type: none"> • States the intuitive idea of a limit and theorem on limits • Proves $\lim_{x \rightarrow a} \left(\frac{x^n - a^n}{x - a} \right) = na^{n-1}$ where n is a rational number • Applies the above theorem 	08

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
12. Investigates straight lines in terms of cartesian co-ordinates	12.1 Describes the rectangular Cartesian coordinate systems	<ul style="list-style-type: none"> Rectangular Cartesian co-ordinates <ul style="list-style-type: none"> Co-ordinate axes, origin of co-ordinates, Quadrants, abscissa, ordinate 	<ul style="list-style-type: none"> Plots points on a Cartesian plane 	01
	12.2 Finds the distance between two points and the area of a triangle	<ul style="list-style-type: none"> Distance between two points Co-ordinates of the point dividing the straight line segment joining two points in a given ratio Area of a triangle with given vertices 	<ul style="list-style-type: none"> Writes the formulae for the distance in between two points in a Cartesian plane Writes the co-ordinates of a point which divides the line joining two given points at a given ratio Finds the area of a triangle when the vertices are given 	06
	12.3 Describes the equation of a straight line	<ul style="list-style-type: none"> Straight line <ul style="list-style-type: none"> Inclination and gradient of a straight line (for straight lines not parallel to the x axis) x-intercept, y-intercept of a straight line 	<ul style="list-style-type: none"> Finds the gradient of a straight line Finds x-intercept and y-intercept of a straight line 	06

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
11.Determines	12.4 Interprets the equation of a straight line	<ul style="list-style-type: none"> Different forms of the equation of a straight line <ul style="list-style-type: none"> Point - gradient form $y - y_1 = m(x - x_1)$ Gradient-Intercept form $y = mx + c$ Two point form $y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1)$ Intercept form $\frac{x}{a} + \frac{y}{b} = 1$ General form $ax + by + c = 0$ Interpretation of the general form when (i) $a = 0$, (ii) $b = 0$, (iii) $c = 0$ 	<ul style="list-style-type: none"> Obtains equation of straight lines in Point - Gradient form Obtains equation of straight lines in gradient intercept form Obtains equation of straight lines in two point form Obtains equation of straight lines in intercept form Obtains equation of straight lines in General form Interprets of the general form when (i) $a = 0$, (ii) $b = 0$, (iii) $c = 0$ Obtains equation of straight lines according to the data given 	12
	12.5 Derives the equation of a straight line passing through the point of intersection of two given straight lines	<ul style="list-style-type: none"> Point of intersection of two straight lines Interpretation of the equation $U + \lambda V = 0$, where $U=0$ and $V=0$ are the equations of two intersecting straight lines 	<ul style="list-style-type: none"> Finds the coordinate of the point of intersection of two non parallel lines Interprets and uses the equation $U + \lambda V = 0$ 	05

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
13. Uses the derivatives of a function to solve problems.	13.1 Interprets the derivative of a function	<ul style="list-style-type: none"> Definition of the derivative of $f(x)$ at a point x_0 as $\lim_{h \rightarrow 0} \frac{f(x_0 + h) - f(x_0)}{h}$ Limiting position of the line joining two points on a curve as the tangent to the curve <ul style="list-style-type: none"> Slope of the tangent line Rate of change as a derivative 	<ul style="list-style-type: none"> Defines the derivative at a point Obtains the slope of a tangent line of a point on a curve Describes rate of change as a derivative Applies rate of change 	04
	13.2 Finds the derivatives of polynomials, exponential and logarithmic functions.	<ul style="list-style-type: none"> Derivatives of the functions $x^n, e^x, \ln x$ 	<ul style="list-style-type: none"> Obtains the formulae $\frac{d}{dx}(x^n) = nx^{n-1}$, $\frac{de^x}{dx} = e^x$, $\frac{d}{dn}(\ln x) = \frac{1}{x}$ 	06
	13.3 Uses the formulae for the derivative of the sum, product and the quotient of two function	<ul style="list-style-type: none"> Rules for finding the derivatives of a sum, product and quotient of two functions and their applications 	<ul style="list-style-type: none"> Derives formulae for sum, product and quotient of two functions and applies to differentiable functions Solves problems involving above rules 	05
	13.4 Uses the chain Rule to find the derivative	<ul style="list-style-type: none"> Chain rule for composition of functions 	<ul style="list-style-type: none"> Applies chain rule to find the derivative of compound functions 	06

Competency	Competency Level	Contents	Learning outcomes	No. of Periods	
decreasing local g ntal related rates	13.5	Determines the behaviour of a function using derivatives	<ul style="list-style-type: none"> Increasing functions, Decreasing functions . Stationary points of functions Local maximum and local minimum 	<ul style="list-style-type: none"> Describes increasing and decreasing function by using differentiation Finds stationary points Finds local maximum and local minimum 	04
	13.6	Sketches simple curves using derivatives	<ul style="list-style-type: none"> Sketching simple curves using derivatives (horizontal and vertical asymptotes) 	<ul style="list-style-type: none"> Sketches simple curves using derivative States vertical and horizontal asymptotes 	07
	13.7	Uses derivatives to solve problems involving related rates	<ul style="list-style-type: none"> Related rates 	<ul style="list-style-type: none"> Solves problems involving related rates 	08

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
14.Finds indefinite and definite integrals of functions	14.1 Identifies Integration as the reverse process of differentiation (anti-derivative of function)	<ul style="list-style-type: none"> • Antiderivatives and indefinite Integrals • Properties of integrals <ul style="list-style-type: none"> • $\int [f(x) \pm g(x)] dx = \int f(x) dx \pm \int g(x) dx$ • $\int \lambda f(x) dx = \lambda \int f(x) dx$ 	<ul style="list-style-type: none"> • Finds integrals using results of derivative • Uses the theorems on integration 	04
	14.2 Identifies integrals of standard functions and results of intergtation	<ul style="list-style-type: none"> • Integrals of standard functions x^n, e^x • Standard results in intergtation $\int [f(x)]^n f'(x) dx = \frac{[f(x)]^{n+1}}{n+1} + c$ $\int \frac{f'(x)}{f(x)} dx = \ln f(x) + c$ 	<ul style="list-style-type: none"> • Solves integral problems using standard results • Uses the formula to find integral • Uses partial fractions to find integral 	08
	14.3 Determines definite integrals using the fundermental theorem of calculus	<ul style="list-style-type: none"> • Definite integrals <ul style="list-style-type: none"> • $\int_a^b f(x) dx$ notation 	<ul style="list-style-type: none"> • States the fundermental theorem of calculus • Finds the values of definite integrals • Uses the properties of definite integrals 	06

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
	14.4 Uses different methods for integration	<ul style="list-style-type: none"> Integration of rational functions using partial fractions 	<ul style="list-style-type: none"> Solves problems using partial fractions 	04
	14.5 Integration using the method of integration by parts	<ul style="list-style-type: none"> $\int u dv = uv - \int v du$ 	<ul style="list-style-type: none"> Uses integration by parts to integrate suitable problems 	04
	14.6 Determines the area of a region bounded by curves using integration	<ul style="list-style-type: none"> Uses of integrations <ul style="list-style-type: none"> Area under a curve Area between two curves 	<ul style="list-style-type: none"> Uses definite integral to find area under curve Uses definite integral to find area between two curves 	08
	14.7 Uses method of approximation to solve problems	<ul style="list-style-type: none"> Numerical integration using trapezium rule and Simpson's rule 	<ul style="list-style-type: none"> Solves problems by using <ul style="list-style-type: none"> Trapezium rule Simpson's rule 	08

Mathematics - II

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
1. Interprets the basics of statistics	1.1 Investigates the nature of statistics	<ul style="list-style-type: none"> • Introduction to of statistics • Nature of statistics <ul style="list-style-type: none"> • Descriptive statistics • Inferential statistics • Connection between diescriptive, inferential and probability <ul style="list-style-type: none"> • Probability • Application of Statistics 	<ul style="list-style-type: none"> • Explains statistics and its nature • Explains probability and distribution theory • Distinguish between descriptive and inferential • Identify the role of probability in (inferential) statistics • Identify some application of statistics 	03
	1.2 Manipulates data to obtain information	<ul style="list-style-type: none"> • Data and Information • Experiments and Data • Controlled Experiments censuses and surveys • Types of Data <ul style="list-style-type: none"> • Qualitative and Quantitative • Norminal and Ordinal • Discrete data • Continuous data 	<ul style="list-style-type: none"> • Explains the types of data • Describes the difference between data and information 	03

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
2. Presents data and information systematically	2.1 Classifies data	<ul style="list-style-type: none"> • Techniques of classifies data <ul style="list-style-type: none"> • Classification of data as a process of arranging objects • Aims of classification • Basis of classification. 	<ul style="list-style-type: none"> • Classifies data • States aims and basic of classification of data 	02
	2.2 Tabulates data	<ul style="list-style-type: none"> • Techniques of tabulation <ul style="list-style-type: none"> • Construction of a frequency table • Ungrouped frequency distribution • Grouped frequency distribution • Construction of two way tables • Importance of tabulation 	<ul style="list-style-type: none"> • Tabulates the data using ungrouped and grouped frequency distribution • Interprets the tabulated data 	02
	2.3 Represents data and information using charts	<ul style="list-style-type: none"> • Techniques of refresenlation <ul style="list-style-type: none"> • Importance of charts • Limits and rules • Geometrical forms • Bar charts • Types of bar charts • Pie charts • Maps and graphs 	<ul style="list-style-type: none"> • Identified the significant of using charts • Uses charts to represent data 	03

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
	2.4 Represents data and information graphically	<ul style="list-style-type: none"> • Graphical techniques (lines and curve forms) <ul style="list-style-type: none"> • Line graphs • Line graphs for more than one variable • Histogram • Frequency polygon • Smooth frequency curves • Ogives or cumulative frequency curves 	<ul style="list-style-type: none"> • Uses the methods of graphical data representation 	03
3. Interprets the behaviour of a frequency distribution	3.1 Analyses mean as a measure of central tendency	<ul style="list-style-type: none"> • Mean for classified unclassified data <ul style="list-style-type: none"> • weighted mean • geometric mean 	<ul style="list-style-type: none"> • Finds the central tendency measurement 	10
	3.2 Interprets the frequency distribution in terms of values of relative positions	<ul style="list-style-type: none"> • Measures of relative positions of a frequency distribution. <ul style="list-style-type: none"> • Median • quartiles • deciles • Percentiles 	<ul style="list-style-type: none"> • Finds the relative position of frequency distribution 	14

Competency	Competency Level	Contents	Learning outcomes	No. of Periods	
	3.3	Analyses mode as a measure of central tendency	<ul style="list-style-type: none"> • Mode of a frequency distribution 	<ul style="list-style-type: none"> • Finds the mode as a measure of central tendency 	04
	3.4	Uses suitable measures of central tendency to reach decisions on frequency distributions.	<ul style="list-style-type: none"> • Relative importance of measures of central tendency 	<ul style="list-style-type: none"> • States the relative importance of measure of central tendency 	04
	3.5	Interprets the dispersion of a distribution using measures of deviation	<ul style="list-style-type: none"> • Measures of dispersion • Importance of measures of dispersion • Types of dispersion <ul style="list-style-type: none"> • Range • Inter quartile range • semi interquartile range (Quartile deviation) • Mean deviation • Variance • Standard deviation 	<ul style="list-style-type: none"> • Uses suitable measure of dispersion to make decision on frequency distribution • States the measures of dispersion and their importancy • States pool mean and pool variance • Calculates pool mean and pool variance. 	10
	3.6	Interprets coefficient of variation as a measures of dispersion.	<ul style="list-style-type: none"> • Coefficient of variation (Pierson) 	<ul style="list-style-type: none"> • Explains coefficient of variation and solves problems 	03

Competency	Competency Level	Contents	Learning outcomes	No. of Periods	
	3.7	Decides on the shape of a distribution using measures of skewness	<ul style="list-style-type: none"> Measures of skewness <ul style="list-style-type: none"> Kal Pearson's measure of skewness $sk_1 = \frac{\text{mean-mode}}{\text{Stand ard deviation}}$ $sk_2 = \frac{3(\text{mean} - \text{median})}{\text{Stand ard deviation}}$ 	<ul style="list-style-type: none"> Defines the measure of skewness States relationship between mean, median and mode Finds measures of skewness Describes the shape of distribution using measures of skewness 	02
4. Analyses random phenomena mathematically	4.1	Determines the events of a random experiment	<ul style="list-style-type: none"> Experiments and events <ul style="list-style-type: none"> Types of experiments Deterministic experiments Non-deterministic or random experiments Possible outcomes of an experiment Sample space of an experiment Events <ul style="list-style-type: none"> Simple event, composite events, null event. complementary events, Union of two events, intersection of two events Mutually exclusive events Exhaustive events Equally probable events Event space 	<ul style="list-style-type: none"> Explains random experiments Defines sample space and sample points Defines an event Explains types of events Classifies events Defines union and intersection of two events Explains mutually exclusive events Exhaustive events Explains equally probable events Explains event space Solves problems involving above concepts. 	08

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
	4.2 Interprets probability	<ul style="list-style-type: none"> Classical definition of probability <ul style="list-style-type: none"> Frequency approximation of probability Axiomatic definition of probability Laws of Probability <ul style="list-style-type: none"> $P(A) = P(A \cap B) + P(A \cap B')$ $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ 	<ul style="list-style-type: none"> States classical definition of probability and its limitation States the axiomatic definition States the frequency approximation to probability Proves the theorems in probability using axiomatic definition Proves theorems in probability using axiomatic definition and laws of probability 	10
	4.3 Decides the possibility of an event in terms of conditional Probability	<ul style="list-style-type: none"> Conditional probability <ul style="list-style-type: none"> Definition Conditional Probability outcomes Chain rule Chain rule for two events Extension of the chain rule for more than two events 	<ul style="list-style-type: none"> Defines conditional probability States and proves the theorems on conditional probability Solves problems involving conditional probability States chain rule and its extension 	08
	4.4 Interprets the independence of two random events	<ul style="list-style-type: none"> Independent events Independence of several events 	<ul style="list-style-type: none"> Uses independence of two or three events 	04
	4.5 Uses Baye's Theorem as a derivative of the Total Probability Theorem	<ul style="list-style-type: none"> Partition of the sample space Total probability Theorem Baye's Theorem 	<ul style="list-style-type: none"> Defines partition of a sample space Proves and uses the theorem on total probability States bay's theorem and applies it in problems 	08

Competency	Competency Level	Contents	Learning outcomes	No. of Periods	
	4.6	Interprets random variables	<ul style="list-style-type: none"> • Possible values of a random variable • Discrete and continuous random variables 	<ul style="list-style-type: none"> • Defines random variable • Defines discrete and continuous random variables 	02
	4.7	Analyses the properties of a probability distribution of a continuous and a discrete random variable	<ul style="list-style-type: none"> • Probability distribution of a discrete random variable • Probability density function of a continuous random variable 	<ul style="list-style-type: none"> • States possible values of random variable • Describes probability distribution of a random variable. • Describes probability density function of a continuous random variable. 	12
	4.8	Interprets the mathematical expectation of a random variable	<ul style="list-style-type: none"> • Mathematical expectation <ul style="list-style-type: none"> • Mean • Variance 	<ul style="list-style-type: none"> • Defines mathematical expectation • Finds mean and variance for discrete random variable and continuous random variable 	12
	4.9	Determines the cumulative distribution function of a random variable	<ul style="list-style-type: none"> • Cumulative distribution function of a random variable 	<ul style="list-style-type: none"> • Defines Cumulative distribution of a function • Solves problems involving above mean median mode 	20
	4.10	Constructs models for special discrete probability distributions, calculates probability and interpret it	<ul style="list-style-type: none"> • Discrete probability distributions <ul style="list-style-type: none"> • Bernoulli distribution • Discrete uniform distribution • Binomial distribution • Poisson distribution 	<ul style="list-style-type: none"> • Describes Bernoulli distribution • Describes Binomial distribution • Solves problems involving above distributions. 	14
	4.11	Calculates probability using theoretical models and interprets the density functions of special continuous distribution	<ul style="list-style-type: none"> • Continuous distribution <ul style="list-style-type: none"> • Uniform distribution • Normal and standard normal distributions 	<ul style="list-style-type: none"> • Describes uniform distributions. • Describes normal and standard normal distributions. • Solves problems involving above distributions. 	15

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
5. Determines the optimum solution of a linear programming problem	5.1 Constructs a linear Programming model	<ul style="list-style-type: none"> • Construction of a linear programming model <ul style="list-style-type: none"> • Decision variable • Objective function • Notation in standard form • Constraints • Non-negative conditions 	<ul style="list-style-type: none"> • Constructs linear programming • States decision variables • Constructs objective functions • Defines constraints • States conditions 	10
	5.2 Determines the solution of a linear programming problem graphically	<ul style="list-style-type: none"> • Linear programming graphical solution <ul style="list-style-type: none"> • Feasible region • Solution of a maximising model • Solution of a minimising model • Problems with <ul style="list-style-type: none"> • unfeasible solution • Single solution • Multiple solutions problems • Networks and their application 	<ul style="list-style-type: none"> • Identifies the feasible and unfeasible region. • Finds the solutions of maximising model and minimising model. • Obtains unfeasible solution, single solutions, and multiple solutions in problems. • Solves problems involving linear programming • Defines networks and their application 	15

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
6. Uses Permutation and combination to solve Mathematical problems	6.1 Uses Permutations as a technique of solving mathematical problems	<ul style="list-style-type: none"> • Fundamental principle of counting <ul style="list-style-type: none"> • Clarification by examples • Factorial notation • The number of permutations of n distinct objects taken $r(\leq n)$ at a time • Symbol ${}^n P_r$ • The number of permutations of n objects not all distinct 	<ul style="list-style-type: none"> • Explains the fundamental principle's of counting defines the factorial and states the recursive relation for factorial. • Defines ${}^n P_r$ and obtains the formulae for ${}^n P_r$ • Finds the permutation of n objects different 	10
	6.2 Uses combinations as a technique of solving Mathematical problems	<ul style="list-style-type: none"> • Concept of combination • The number of combination of n distinct object, taken r at a time. • symbol and formula, problems with particular ${}^n C_r$ values for n and r are considered, where ${}^n C_r = \frac{n!}{r!(n-r)!}$ <p>Properties of ${}^n C_r$</p> <ul style="list-style-type: none"> • ${}^n C_0 = {}^n C_n = 1$ and • ${}^n C_r = {}^n C_{n-r}$ • ${}^{n+1} C_r = {}^n C_{r-1} + {}^n C_r$ 	<ul style="list-style-type: none"> • Defines ${}^n C_r$ and finds a formula for ${}^n C_r$ • Defines combination. • Explains the difference between permutations and combinations. • Applies the formulae to related problems. • Writes the properties of ${}^n C_r$ 	14

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
7. Analyses projects by using networks	7.1 Describes net works	<ul style="list-style-type: none"> • Networks and its applications • Definition of Networks and its terminology 	<ul style="list-style-type: none"> • Defines network and applies it in problems 	10
	7.2 Solves problems by using network	<ul style="list-style-type: none"> • Critical path • Reducing spanning tree problem • Maximum flow • Planning projects and critical path 	<ul style="list-style-type: none"> • Introduces spanning tree • Describes maximum flow • Solves problems involving planning projects and critical path. 	15

Competency	Competency Level	Contents	Learning outcomes	No. of Periods	
8. Manipulates Determinants as a mathematical model of solving problems	8.1	Interprets the properties of determinants of order two and three	<ul style="list-style-type: none"> Properties 	<ul style="list-style-type: none"> $\begin{vmatrix} a & b \\ p & q \end{vmatrix} = -\begin{vmatrix} p & q \\ a & b \end{vmatrix}$ 	04
	8.2	Solves equations by using two or three variable	<ul style="list-style-type: none"> Introduction : By solution of two simultaneous equations with two unknowns. <ul style="list-style-type: none"> Interchange of two rows or two columns changes the sign of the determinant If two rows or two columns of a determinant are identical the determinant becomes zero If k is common factor of all the elements in a row or a column, then k is a common factor of the determinant 	$ax + by = c$ $px + qy = r$ Expresses the above equation as follows $\begin{pmatrix} a & b \\ p & q \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} c \\ r \end{pmatrix}$ $\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} a & b \\ p & q \end{pmatrix}^{-1} \begin{pmatrix} c \\ r \end{pmatrix}$	06

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
9. Manipulates Matrix Algebra	9.1 Describes Matrix Algebra	<ul style="list-style-type: none"> • Definition and notation of of matrices • Elements rows, cloumns size of Matrix row matrix column matrix. • Matrix addition <ul style="list-style-type: none"> • Conformable for addition • Commutative and associative laws for addition • Scalar multiplication • Distributive law for addition over scalar multiplication. 	<ul style="list-style-type: none"> • Identifies matrices • Writes the order of a matrix • Describes the matrix which are compatible for addition and multiplication • Applies disribution laws for addition and multiplication 	08
	9.2 Investigates the properties of square matrices	<ul style="list-style-type: none"> • Square Matrices <ul style="list-style-type: none"> • Unit matrix • Diagonal matrix • Matrix multiplication <ul style="list-style-type: none"> • Compatibility of matrices for multiplication • Illustrating that matrix multiplication is not commutative 	<ul style="list-style-type: none"> • Verifies square matrices by using the definition • Define the compartibility for multiplication of two matrices • Verifies the $AB \neq BA$ for any two matrices • Defines the unit and diagonal matrices 	12

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
		<ul style="list-style-type: none"> • Algebra of square matrices <ul style="list-style-type: none"> • Associativity of matrix multiplication $(AB)C=A(BC)$ • Distributivity of matrix multiplication over addition $A (B + C) = AB + AC$ $(B + C) A = BA + CA$ • $IA = A = AI$, where I is the unit matrix of order same as A • When $f(x)$ is a polynomial in x computation of $f(A)$ • Transpose. <ul style="list-style-type: none"> $(A+B)^T = A^T + B^T$ $(A^T)^T = A$ $(kA)^T = kA^T$, Where k is a scalar. $(AB)^T = B^T A^T$ 	<ul style="list-style-type: none"> • If A, B, C are matrix of same order verifies that the $A(B+C) = AB + AC$ and $(B+C) A = BA + CA$ (Associativity) (Distribution) • Describes the identity matrix and verifies $AI=IA=A$ for all matrix here A and I are with same order • States what is transpose of a matrix and verifies all properties regarding transpose 	

8.0 Learning Teaching Strategies

To facilitate the students to achieve the anticipated outcome of this course, a variety of teaching strategies must be employed. If students are to improve their mathematical communication, for example, they must have the opportunity to discuss interpretations, solution, explanations etc. with other students as well as their teacher. They should be encouraged to communicate not only in writing but orally, and to use diagrams as well as numerical, symbolic and word statements in their explanations.

Students learn in a multitude of ways. Students can be mainly visual, auditory or kinesthetic learners, or employ a variety of senses when learning. The range of learning styles is influenced by many factors, each of which needs to be considered in determining the most appropriate teaching strategies. Research suggests that the cultural and social background has a significant impact on the way students learn mathematics. These differences need to be recognised and a variety of teaching strategies to be employed so that all students have equal access to the development of mathematical knowledge and skills.

Learning can occur within a large group where the class is taught as a whole and also within a small group where students interact with other members of the group, or at an individual level where a student interacts with the teacher or another student, or works independently. All arrangements have their

9.0 School Policy and Programmes

To make learning of Mathematics meaningful and relevant to the students classroom work ought not to be based purely on the development of knowledge and skills but also should encompass areas like communication, connection, reasoning and problem solving. The latter four aims, ensure the enhancement of the thinking and behavioural process of children.

For this purpose apart from normal classroom teaching the following co-curricular activities will provide the opportunity for participation of every child in the learning process.

- Student's study circles
- Mathematical Societies
- Mathematical camps
- Contests (national and international)
- Use of the library
- The classroom wall Bulletin
- Mathematical laboratory
- Activity room
- Collectin historical data regarding mathematics
- Use of multimedia
- Projects

It is the responsibility of the mathematics teacher to organise the above activities according to the facilities available. When organising these activities the teacher and the students can obtain the assistance of relevant outside persons and institution.

In order to organise such activities on a regular basis it is essential that each school develops a policy of its own in respect of Mathematics. This would form a part of the overall school policy to be developed by each school. In developin the policy, in respect of Mathematics, the school should take cognisance of the physical environment of the school and neighbourhood, the needs and concerns of the students and the community associated with the school and the services of resource personnel and institutions to which the school has access.

The school should develop its annual programmes, consisting of a variety of activities for achieving policy goals. In determining the activities to be undertaken during a particular year, the school will need to identify priorities and consider feasibility in relation to time and resource constraints. However, the school could organise a range of activities adequate to cater to the development of the variety of interests and aptitudes of different students.

10.0 Assessment and Evaluation

It is intended to implement this syllabus in schools with the School Based Assessment (SBA) process. Teachers will prepare creative teaching - learning instruments on the basis of school terms.

The First Examination under this syllabus will be held in 2019.

MATHEMATICAL SYMBOLS AND NOTATIONS

The following Mathematical notation will be used.

1. Set Notations

\in	an element
\notin	not an element
$\{x_1, x_2, \dots\}$	the set with elements x_1, x_2, \dots
$\{x / \dots\}$ or $\{x : \dots\}$	the set of all x such that...
$n(A)$	the number of elements in set A
\emptyset	empty set
ξ	universal set
A'	the complement of the set A
\mathbb{N}	the set of natural numbers, $\{1, 2, 3, \dots\}$
\mathbb{Z}	the set of integers $\{0, \pm 1, \pm 2, \pm 3, \dots\}$
\mathbb{Z}^+	the set of positive integers $\{1, 2, 3, \dots\}$
\mathbb{Q}	the set of rational numbers
\mathbb{R}	the set of real numbers
\mathbb{C}	the set of complex numbers
\subseteq	a subset
\subset	a proper subset
$\not\subset$	not subset
$\not\subset$	not a proper subset
\cup	union
\cap	intersection
$[a, b]$	the closed interval $\{x \in R : a \leq x \leq b\}$
(a, b)	the interval $\{x \in R : a < x < b\}$
$[a, b)$	the interval $\{x \in R : a \leq x < b\}$
(a, b)	the open interval $\{x \in R : a < x < b\}$

2. Miscellaneous Symbols

$=$	equal
\neq	not equal
\equiv	identical or congruent
\sqcup	approximately equal
\propto	proportional
$<$	less than
$\dot{<}$	less than or equal
$>$	greater than
$\dot{>}$	greater than
∞	infinity
\Rightarrow	if
\Leftrightarrow	if and only if (iff)

3. Operations

$a + b$	a plus b
$a - b$	a minus b
$a \times b, a \cdot b$	a multiplied by b
$a \div b, \frac{a}{b}$	a divided by b
$a : b$	the ratio between a and b
$\sum_{i=1}^n a_i$	$a_1 + a_2 + \dots + a_n$
\sqrt{a}	the positive square root of the real number a
$ a $	the modulus of the real number a
$n!$	n factorial for $n \in \mathbb{N} \cup \{0\}$
${}^n P_r = \frac{n!}{(n-r)!}, 0 \leq r \leq n$	$n \in \mathbb{N}^+, r \in \mathbb{N}^+ \cup \{0\}$
${}^n C_r = \frac{n!}{r!(n-r)!}, 0 \leq r \leq n$	$n \in \mathbb{N}^+, r \in \mathbb{N}^+ \cup \{0\}$

4. Functions

$f(x)$	the function f of x
$f: A \rightarrow B$	f is a function under which each element of set A has an Image in set B
$f: x \rightarrow y$	the function f maps the element x to the element y
f^{-1}	the inverse the function f
$\frac{g \circ f}{x}$	the composite function of f and g which is defined by $g \circ f(x)$
$\lim_{x \rightarrow a} f(x)$	the limit of $f(x)$ as x tends to a
δx	an increment of x
$\frac{dy}{dx}$	the derivative of y with respect to x
$\frac{d^n y}{dx^n}$	then n^{th} derivative of y with respect to x
$f^{(1)}(x), f^{(2)}(x), \dots, f^{(n)}(x)$	the first, second, ..., n^{th} derivatives of $f(x)$ with respect to x
$\int y dx$	indefinite integral of y with respect to x
$\int_a^b y dx$	definite integral of y w.r.t x in the interval $a \leq x \leq b$
\dot{x}, \ddot{x}, \dots	the first, second, ... derivative of x with respect to time

5. Exponential and Logarithmic Functions

e^x exponential function of x

$\log_a x$ logarithm to the base a of x

$\ln x$ natural logarithm of x

\lg_x logarithm of x to base 10

X, Y, R, \dots

random variables

x, y, r, \dots ect.

values of the random variables X, Y, R etc.

x_1, x_2, \dots

observations

f_1, f_2, \dots

frequencies with which the observations

x_1, x_2, \dots occur

6. Matrices

M a matrix M

M^T the transpose of the matrix M

M^{-1} the inverse of the matrix M

$\det M$ the determinant of the matrix M

$$\bigcup_{i=1}^n A_i = A_1 \cup A_2 \cup \dots \cup A_n$$

$$\bigcap_{i=1}^n A_i = A_1 \cap A_2 \cap \dots \cap A_n$$

\bar{x}

Mean

σ^2

Variance

$\sigma / S / SD$

Standard deviation

7. Probability and Statistics

A, B, C ect.. events

$A \cup B$ union of the events A and B

$A \cap B$ intersection of the events A and B

$P(A)$ probability of the event A

A' complement of the event A

$P(A|B)$ probability of the event A given the event B

8. Probability and Statistics

A, B, C etc ..	events
$A \cup B$	union of the events A and B
$A \cap B$	intersection of the events A and B
$P(A)$	probability of the event A
A'	complement of the event A
$P(A B)$	probability of the event A given that event B is happened
X, Y, R, ...	random variables
x, y, r, \dots ect.	values of the random variables X, Y, R etc.
x_1, x_2, \dots	observations
f_1, f_2, \dots	frequencies with which the observations x_1, x_2, \dots occur

$$\bigcup_{i=1}^n A_i = A_1 \cup A_2 \cup \dots \cup A_n$$

$$\bigcap_{i=1}^n A_i = A_1 \cap A_2 \cap \dots \cap A_n$$

\bar{x} arithmetic mean

σ^2 variance

$\sigma / S / SD$ standard deviation