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

First print 2017

ISBN :

Department of Mathematics
Faculty of Science and Technology
National Institute of Education
www.nie.lk

Printed by :

CONTENTS

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) Combined Mathematics syllabus was conducted in 1998. One of the main reason for the need to revise the earlier syllabus had been that in 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 new 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 Combined Mathematics at G.C.E.(Advanced Level) to those pupils who had followed a competency Based syllabus at Grades 10 and 11.

The student who has learnt Mathematics at Grades 6-11 under the new curriculum reforms through a competency based approach, enters grade 12 to learn Combined Mathematics at Grades 12 and 13 should be provided with abilities, skills and practical experiences for his future needs. and these have been identified and the new syllabus has been formulated accordingly. It is expected that all these competencies would be achieved by pupils who complete learning this subject at the end of Grade 13.

Pupils should achieve the competencies through competency levels and these are mentioned under each competency.

It also specifies the content that is needed for the pupils to achieve these competency levels. The number of periods that are needed to implement the process of Learning-Teaching and Assessment also mentioned in the syllabus.

Other than the facts mentioned regarding the introduction of the new curriculum, what had already been presented regarding the introduction of Combined Mathematics Syllabus earlier which are mentioned below too are valid.

- To decrease the gap between G.C.E. (Ordinary Level) Mathematics and G.C.E. (Advanced Level) Combined Mathematics.
- To provide Mathematics knowledge to follow Engineering and Physical Science courses.
- To provide a knowledge in Mathematics to follow Technological and other course at Tertiary level.
- To provide Mathematics knowledge for commercial and other middle level employment.
- To provide guidance to achieve various competencies on par with their mental activities and to show how they could be developed throughout life.

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, speck 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 ad 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 Proposed Term Breakdown of the Syllabus
Grade - 12

Competency Level	Content	Number of Periods
	Term I	
Mathematics -I		
1.1, 1.2,1.3	• Real number system	14
2.1,2.2	• Algebra of sets	12
3.1	• Mathematical logic	10
5.1, 5.2	• One variable functions	20
6.1, 6.2, 6.3, 6.4	• Polynomials	38
Mathematics -II		
1.1, 1.2	• Basics of Statistics	06
2.1, 2.2,2.3,2.4	• Data,data representation	10
	Term II	
Mathematics -I		
12.1, 12.2, 12.3, 12.4, 12.5	• Straight lines	30
7.1, 7.2	• Rational functions and logarithm	30
4.1	• Methods of proofs	12
Mathematics -II		
3.1,3.2	• Measures of central tendency	24
	Term III	
Mathematics -I		
8.1, 8.2, 8.3	• Inequalities	24
11.1	• Limits	08
Mathematics -II		
3.3, 3.4,3.5, 3.6, 3.7	• Frequency distribution	23
4.1, 4.2	• Random experiments and probability	18
6.1, 6.2	• Permutation and combination	24

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 **Mathematics -II** 4.3, 4.4,4.5, 4.6, 4.7,4.8.4.9	• Derivatives • Probability	40 66
	Term II	
Mathematics -I 14.1, 14.2, 14.3, 14.4, 14.5,14.6. 14.7 ` **Mathematics -II** 4.10 5.1, 5.2 8.1,8.2 9.1, 9.2	• Integration • Discrete probality distribution • Linear programing • Deterninants • Matrices	40 14 25 10 20
	Term III	
Mathematics -I 9.1, 9.2 10.1, 10.2, 10.3 **Mathematics -II** 4.11 7.1,7.2	• Binomial expansion • Series • Continuous probablity distribution • Networks	16 26 15 25

Subject	Number of Periods	Total
First Term		
Mathematics I	**94**	
Mathematics II	**16**	**110**
Second Term		
Mathematics I	72	
Mathematics II	24	96
Third Term		
Mathematics I	32	
Mathematics II	65	97
Fourth Term		
MathematicsII	40	
Mathematics I	66	106
Fifth Term		
Mathematics I	40	
Mathematics II	69	109
Sixth Term		
Mathematics I	42	
Mathematics II	40	82
Total		600

6.0 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	• Review of the of the real number system • Notations for sets of numbers • Geometrical representation of a real number	• Writes correct notations for sets of numbers • Represents real numbers geometrically	04
	1.2 Uses surds and decimals to represens real numbers	• Decimal representation of a real number ú Finite decimals ú Infinite decimals ú Recurring decimals ú Surds	• Classifies decimal numbers • Classifies real numbers • Writes, conjugate of a surd • Rationalises the denominator of expressions with surds • Uses arithmetical operation on surds	04
	1.3 Uses Exponents (indices) and radicals to communicate numbers	• Positive integral Exponents (indices) • Negative integral and zero exponents • Fractional exponents • Rationalizing denominantors	• Defines indicies. • Classifies positive integral exponents, negative integral exponets, 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	• Language of sets and elements of a set ú Universal set, Null set, Finite set and Infinite set, Cardinality of a set ú Subsets, proper subsets,equality of two sets, and Power set	• Explains set notations • Explains and writes the notations of universal set and null set • Explains finite sets and infinite sets • Explains cardinality of a set and writes its notation • 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	• Set operations ú Intersection and Union ú Complement, relative complement ú Set identities • The formula	• States the set operations also with venn diagrams • Writes the formula of set identities explains	06
3. Manipulates Mathematical Logic	3.1 Identify statements	• Statements • Logical connectives and compound statements • Truth tables • Conditional statements • Quantifiers • Compound statements ú Construction of the truth table • Logical equivalents • Predicates ú Symbolization of Predicates	• Identifies the different types of statements • Writes the definition of all types of statements • Writes the constructions of truth table • States the definitions of logical equivalents and predicates of a event • 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	• Methods of proof ú Direct proof ú Proof by contradiction ú Proof by Mathematical induction	• States type of proof • Describes direct proof, proof by contradiction and proof by mathematical induction	12
5. Analyses functions of a real variable	5.1 Investigates functions	• Intiutive idea of a function as one-one or many-one relation ú Domain • Graph of a function, vertical line test for a function • Elementry functions $f(x)=ax+b$, $f(x)=\lvert x\rvert$, $f(x)=x^2$, $f(x)=\frac{1}{x}$, $(x\neq 0)$ $f(x)=\sqrt{x}, x\geq 0$, $f(x)=\frac{1}{x}$, $(x\neq 0)$ • Graphing functions using translations (shifting)	• Explains the Intiutive idea of a function • Explains the domain of a function • Recognizes special functions • Sketches functions • Sketches functions using translations (shifting)	10

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
	5.2 Investigates operations of functions	• Basic operation +, -, ×, and ÷ • Composite functions • Inverse functions ú Definition of inverse function ú Finding the inverse function	• performs basic operations • Defines composite functions • Writes the notations for composite functions • States the definition of inverse function and finds the inverse function	10
6. Analyses polynomials	6.1 Investigates polynomials	• Polynomials in one variable ú Degree, leading term and leading coefficient ú Equality of two polynomials	• Defines a polynomial in a single variable • States the condition for two polynomials to be equal	15
	6.2 Uses mathematical operations involving polynomials	• Mathematical operations involving polynomials ú Addition, subtraction ú Multiplication ú Division, long division ú Synthetic division by a linear expression ú Remainder theorem ú Factor theorem	• Explain the basic mathmatical operations on polynomilas • Divides a polynomial by another polynomial • 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 theoram. • Solves the polynomials equations (up to 4th order) • Defines zeros of a polynomials	10

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
	6.3 Investigates quadratic functions and their properties	• Quadratic functions ú Completing the square ú Discriminant ú Least and greatest value ú Drawing the graph • Applications of quadraric functions	• 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 the quardratic functions	10
	6.4 Investigates the quadratic equations	• Quadratic equation ú Solution by completion of square ú Graphical solution • Use of quadratic formula ú Discriminant Δ • Analysis of roots ú Real and distinct ú Real and coincident ú Not real • Solution of simultaneouss equations, of one equation is linear in two variables and the other equation quadratic in one or both variables	• Explains the roots α and β of a quadratic equations $ax^2 + bx + c = 0$ • Finds the roots of a quadratic equations • Describes the nature of the roots of a quadratic equations • Expreses the sum and products of the roots of quadratic equations inform of its coefficients • contructs quadratic equations where roots are symmetric functions of α and β • Solves problems involving quadratic functions and quadratic equations	03

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
7. **Investigates rational functions**	7.1 Resolution of a rational function into partial fractions	• Rational functions ú Proper rational functions ú Improper rational functions • Partial fractions ú Partial fractions of proper rational functions - with distinct factors in the denomiator - with recurring fators in the denominator ú Partial fractions of improper rational functions	• Defines rational functions • Defines proper rational expressions and inpropper rational expressions • Defines rational functions • Finds patial fractions of rational expressions (not more than 4 unknowns are expected)	15
	7.2 Analyses the Exponential and Logarithmic functions	• Exponential function and its properties ú Graphs of growth and decay of propulation ú definition of e ú Properties of e^x ú Graph of e^x • Logarithmic function and its properties ú Properties of lnx ú Change of base ú Graph of lnx • Examples on compound Interest, Population growth etc.	• 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 lnx • Writes change of base of a logarithmic function • Draws the graph of lnx • Compares the relations between lnx and e^x • Finds the compound Interest, population growth, using proper equation.	15

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
8.Manupulates inequalities.	8.1 Solves problems involving linear and quadratic in-equalities	• inequalities • Linear inequalities • Quadratic inequalities • Simultaneous linear inequalities by using graphs	• Solves linear and quadratic inequalities • Solves Simultaneous inequalities	10
	8.2 Solves quadratic inqualites using graphical methed	• quadratic inequalities using graphs	• Solves quadratic and simultaneous inequalities using graphs	06
	8.3 Solves inequalities involving rational functions.	• Inequalities of the form $\frac{f(x)}{g(x)}$ where $f(x)$, $g(x)$ are polynomials of x (degree ≤ 3) and $g(x) \neq 0$	• Solves inequalities of the form $\frac{f(x)}{g(x)}$ where $f(x)$, $g(x)$ are polynomials of x (degree ≤ 3) and $g(x) \neq 0$	08
9. Explores the binomial expansion for positive integral indices.	9.1 Describes the basic properties of the binomial expansion.	• Expansion of $(1 + x)^n$ expressing the coefficients in the form ${}^nC_r$ • Application of $(1 + x)^n$	• Defines • Expands $(1+x)^n$ using binomial theorem • Writes the general term in the expansion of $(1+x)^n$	08
	9.2 Applies binomial theorem	• Expansion of $(a + x)^n$ $(a+x)^n = \sum_{r=0}^{n} {}^nC_r a^{n-r} x^r$ • Application of Binomial theorem	• Expands $(a+x)^n$ using binomial theorem • Writes the general term in the expansion of $(a+x)^n$	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.	• Series • Summation,General term	• Finds the sum of arithmetic and geometric series by using sigma notation	08
	10.2 Solves problems involving arithmetic and geometric series.	• Sigma notation • $\sum_{r=1}^{n}(kU_r) = k\sum_{r=1}^{n}U_r$ • $\sum_{r=1}^{n}(U_r + V_r) = \sum_{r=1}^{n}U_r + \sum_{r=1}^{n}V_r$	• Writes the series using $\sum$ notation and find the sum • Applications of of arithmetic and geometric series by using sigma notation	08
	10.3 finds sums of elementary series	• $\sum_{r=1}^{n} r, \sum_{r=1}^{n} r^2, \sum_{r=1}^{n} r^3$ and their applications	• 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 ormulae to find the sumation of series	10

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
11.Ditermines the limit of the function	11.1 Interpretes the limit of a function. Solves problems using the theorems on limits. Uses the limit; $\lim_{x\to a}\left(\frac{x^n-a^n}{x-a}\right)=na^{n-1}$ to solve problems	• Intuitive idea of a limit • Theorems on limits • Proof of $\lim_{x\to a}\left(\frac{x^n-a^n}{x-a}\right)=na^{n-1}$,	• States the intutive idea of a limit and theorem on limits • Proves $\lim_{x\to a}\left(\frac{x^n-a^n}{x-a}\right)=na^{n-1}$ where n is a rational number • applies the above theorem	08

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
12. Investigates a straight line in terms of cartesian co-ordinates	12.1 Describes the rectanqular Cartesion coordinate systems	Rectangular Cartesian co-ordinates ú Co-ordinate axes, origin of co-ordinates, Quadrants, abcissa, ordinate	• Plots points on a Cartesian plane	01
	12.2 Finds the distance between two points and the area of a triangle	ú Distance between two points ú Co-ordinates of the point dividing the straight line segment joining two points in a given ratio ú Area of a triangle with given vertices	• Writes the formulae for the distance in between two points in a Cartesian plane • Writes the co-ordinaties of a point which divides a 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	• Straight line ú Inclination and gradient of a straight line (for straight lines not parallel to the x axis) ú *x*-intercept, *y*-intercept of a straight line	• Finds the gradiant of a straight line • Finds *x*-intercept and *y*-intercept of a straight line	06

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
	12.4 Interprets the equation of a straight line	• Different forms of the equation of a straight line ú Point - gradient form $y-y_1=m(x-x_1)$ ú Gradient-Intercept form $y=mx+c$ ú Two point form $y-y_1=\frac{y_2-y_1}{x_2-x_1}(x-x_1)$ ú Intercept form $\frac{x}{a}+\frac{y}{b}=1$ ú General form $ax+by+c=0$ ú Interpretation of the general form when $(i)a=0$, $(ii)b=0$, $(iii)c=0$	• Obtains equation of straight lines according to the data given (i) Point - Gradient form $y-y_1=m(x-x_1)$ (ii) Gradient Intercept form $y=mx+c$ (iii) Two point form $\frac{y-y_1}{y_1-y_2}=\frac{x-x_1}{x_1-x_2}$ (iv) Intercept form $\frac{y-y_1}{y_1-y_2}=\frac{x-x_1}{x_1-x_2}$ (v) General form $ax+by+c=0$	12
	12.5 Derives the equation of a straight line passing through the point of intersection of two given straight lines	• 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	• Finds the coordinate of the point of intersection of two non parallel lines • Interprets and usees 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	• Definition of the derivative of $f(x)$ at a point x_0 as $\lim_{\delta x \to 0} \frac{f(x_0+\delta x)-f(x_0)}{\delta x}$ • Limiting position of the line joining two points on a curve as the tangent to the curve ú Slope of the tangent line • Rate of change as a derivative	• 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 poloynomials, exponential and logarithmic functions.	• Derivatives of the functions $x^n, e^x, \ln\lvert x\rvert$	• Obtains the formulae $\frac{d}{dx}(x^n)=nx^{n-1}$, $\frac{d}{dn}(\ln\lvert x\rvert)=\frac{1}{x}$	06
	13.3 Uses the formulae for the derivative of the sum, product and the quotient of two function	• Rules for finding the derivatives of a sum, product and quotient of two functions and their applications	• Derives formulae for sum, product and quotient of two functions and applies to differentiable functions	05
	13.4 Uses the chain Rule to find the derivative	• Chain rule for composition of functions	• Applies chain rule to find the derivative of a composite function	06

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
	13.5 Determines the behaviour of a function using derivatives	• Increasing functions, Decreasing functions . • Stationary points of functions • Local maximum and local minimum	• Describes increasing and decreasing function by using differentiation • Finds stationarypoints • Finds local maximum and local minimum	04
	13.6 Sketches simple curves using derivatives	• Sketching simple curves using derivatives (horizontal and vertical asymptotes)	• Draws simple curves using derivative • States vertical and horizontal asymptotes	07
	13.7 Uses derivatives to solve problems involving related rates	• Related rates	• Solves problems involving related rates	08

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
14.Find indefinite and definite integers of functions	14.1 Identifies Intergtation as the reverse process of differentiation (anti-derivative of function)	• Antiderivatives and indefinite Integrails • Properties of intergrals ú $\int[f(x)\pm g(x)]dx=\int f(x)dx\pm\int g(x)dx$ ú $\int \lambda f(x)dx=\lambda\int f(x)dx$	• Finds intergrals using results of derivative • Uses the theorems on integration	04
	14.2 Identifies integrals of standard functions and results of intergtation	• Integrals of standard functions x^n, e^x • Standard results in intergation $\int[f(x)]^n f'(x)dx=\frac{[f(x)]^{n+1}}{n+1}+c$ $\int\frac{f'(x)}{f(x)}dx=\ln\lvert f(x)\rvert+c$	• Solves integral problems using standard results • Observes the function and various methods according to the data	06
	14.3 Determines definite integrals using the fundermental theorem of calculus	• Definite integrals ú $\int_a^b f(x)dx$ notation	• States the funddermental 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	• Integration of rational functions using partial fractions	• Solves problems using partial fractions	04
	14.5 Integration using the method of integration by parts	• $\int udv = uv - \int vdu$	• Uses integration by parts to integrate suitable problems	04
	14.6 Determines the area of a region bounded by curves using integration	• Uses of integrations ú Area under a curve ú Area between two curves	• 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	Numerical integration using trapezium rule and Simpson's rule	• Solves problems by using ú Trapezium rule ú 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	• Introduction to of statistics • Nature of statistics ú Descriptive statistics ú Inferential statistics ú Probability and Distribution Theory ú Connection between diescriptive, inferential and probability theory ú Application of Statistics	• Explains what is statistics and nature • Describes probability an distribution theory	03
	1.2 Manipulates data to obtain information	• Data and Information • Experiments and Data • Controlled Experiments and surveys • Types of Data ú Discrete data ú Continuous data • Information • Distinction between data and information	• 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 and information.	• Techniques of presenting data • Classification of data ú Classification of data as a process of arranging objects ú Aims of classification ú Basis of classification.	• Classifies data • States aims and basic of classification of data	02
	2.2 Tabulates data and information	• Techniques of tabulation ú Construction of a frequency table ú Ungrouped frequency distribution ú Grouped frequency distribution ú Construction of two way tables ú Importance of tabulation	• Tabulates the data • State the presentation techniques of data	02
	2.3 Represents data and information using charts	• Techniques ú Importance of charts ú Limits and rules ú Geometrical forms ú Bar charts ú Types of bar charts ú Pie charts ú Maps and graphs	• Uses charts to represent data	03

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
	2.4 Represents data and information graphically	• Graphical techniqes (lines and curve forms) ú Line graphs ú Line graphs for more than one variable ú Histogram ú Frequency polygon ú Smooth frequency curves ú Ogives or cumulative frequency curves ú Cumulative percentile curves.	• Uses methods of graphical data	03
3. Interprets the behaviour of a frequency distribution	3.1 Analyses mean as a measure of central tendency	Mean for classified & unclassified data ú weighted mean ú geometric mean	• Finds the central tendency measurement	10
	3.2 Interprets the frequency distribution in terms of values of relative positions	• Measures of relative positions of a frequency distribution. ú Median ú quartiles ú deciles and percentiles	• 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 cental tendency	• Mode of a frequency distribution	• Finds the mode as a measure of central tendancy	04
	3.4 Uses suitable measures of central tendency to reach decisions on frequency distributions.	• Relative importance of measures of central tendency	• States the relative importance of measure of central tendency	04
	3.5 Interprets the dispersion of a distribution using measures of deviation	• Measures of dispersion • Importance of measures of dispersion Types of dispersion ú Range ú Inter quartile range ú semi interquartile range (Quartile deviation) ú Mean deviation ú Variance ú Standard deviation	• Use suitable measure of dispersion to make decision on frequency distribution • States the measures of dispersion and their importancy	10
	3.6 Interprets coefficient of variation as a measures of dispersion.	• Coefficient of variation	• 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	• Measures of skewess ú Kal Pearson's measure of skewness ú $sk_1 = \frac{\text{mean-mode}}{SD}$ ú $sk_2 = \frac{3(\text{mean} - \text{median})}{SD}$	• Defines the measure of skewness • Staes relationship between mean ,median,and mode	02
4. Analyses random phenomena mathemati-cally	4.1 Determines the events of a random experiment	• Experiments and events ú Types of experiments ú Deterministic experiments ú Non-deterministic or random experiments ú Possible outcomes of an experiment ú Sample space of an experiment • Events ú Definition ú Simple event, composite events, null event. complementary events, ú Union of two events, intersec-tion of two events ú Mutually exclusive events ú Exhaustive events ú Equally probable events ú Event space	• Explains random experiments • Defines sample space and sample points • Defines an events • Explains types of events • Classifies the events and finds union and untersections	08

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
	4.2 Interprets probability	• Classical definition of probability • Statistical definition of probability • Axiomatic definition of probability • Laws of probability • Laws of Probability ú $P(A)=P(A \cap B)+P(A \cap B')$ ú $P(A \cup B)=P(A)+P(B)-PA \cap B)$	• States classical definition and its limitation • States the axiomatic definition • Proves the theorems in probability using axiomatic definition and solves problems using the above theorem	10
	4.3 Decides the possibility of an event in terms of conditional Probability	• Conditional probability Definition ú Conditional Probability outcomes ú Chain rule ú Chain rule for two events ú Extension of the chain rule for more than two events	• Defines conditional probability • States and proves the theorems on conditional probability • States chain rule and its extension	08
	4.4 Interprets the indepen-dence of two random events	• Independent events • Independence of several events	• Uses independence of two or three events	04
	4.5 Uses Baye's Theorem as a derivative of the Total Probability Theorem	• Partition of the sample space • Total probability • Baye's Theorem	• 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	• Possible values of a random variable • Discrete and continuous random variables	• Defines random variable • Defines discrete and continuous random variables	02
	4.7 Analyses the properties of a probability distribution of a continuous and a dicrete random variable	• Probability distribution of a discrete random variable • Probability density function of a continuous random variable	• States possible values of random variable	12
	4.8 Interprets the mathematical expectation of a random variable	• Mathematical expectation ú Mean ú Variance	• Defines mathematical expectation (Mean & Variance)	12
	4.9 Determines the cumulative distribution function of a random variable	• Cumulative distribution function of a random variable	• Defines Cumulative distribution of a function	20
	4.10 Constructs models for special discrete probability distributions, calculates probability and interpret it	• Discrete probability distributions ú Bernoullis distribution ú Discrete uniform distribution ú Binomial distribution ú Poisson distribution	• States Bernoullis distribution Discrete uniform distribution, Binomial distribution • Uses athe above in problems	14
	4.11 Claculates probability using theoritical models and interprets the density functions of special continuous distribution	• Continuous distribution ú Uniform distribution ú Exponential distribution ú Normal and standard normal distributions	• States uniform distributions, exponential distributions, normal and standard normal distributions • Uses the above in problems	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	• Linear Programming • Construction of a linear programming model ú Decision variable ú Objective function ú Notation in standard form ú Constraints ú Non-negative conditions	• Inteprets the linear model into an inequality and draw garphs. Investigates characteristic	10
	5.2 Determines the solution of a linear programming problem graphically	• Linear programming graphical solution ú Feasible region ú Feasible region ú Solution of a maximising model ú Solution of a minimising model • Problems with ú unfeasible solution ú Single solution ú Multiple solutions problems • Networks and their application • Networks and definition of terms • Applications of networks ú Critical path ú miniming spanning problems ú High flow problems • Planning of projects and ritical path analysis	• 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. • 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	• Fundamental principle of counting • Clarification by examples • Factorial notation • The number of permutations of n distinct objects taken $r(\leq n)$ at a time • Symbol ${}^nP_r$ • The number of permutations of n objectsnot all distinct	• Explains the fundamental principle's of counting defines the factorial and states the recursive relation for factorial. • Defines ${}^nP_r$ and obtains the formulae for ${}^nP_r$ • Finds the permutation of n objects different	10
	6.2 Uses combinations as a technique of solving Mathematical problems	• Concept of combination • The number of combination of n distinct objects taken r at a time. symbol and formula, problems with particular ${}^nC_r$ values for n and r are considered, where $${}^nC_r = \frac{n!}{r!(n-r)!}$$ Properties of ${}^nC_r$ ú ${}^nC_o = {}^nC_n = 1$ *and* ú ${}^nC_r = {}^nC_{n-r}$ ú ${}^{n+1}C_r = {}^nC_{r-1} + {}^nC_r$	• Defines ${}^nC_r$ and finds a formulae for ${}^nC_r$ • Defines combination. • Explains the distinction between permutations and combinations. • Applies the formulae to related problems. • Writes the properties of ${}^nC_r$	14

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
7. Analyses projects by using networks	7.1 Describe networks	• Networks and its applications • Definition of Networks and its terminology	• Defines network and applies it in problems	10
	7.2 Solves problems by using network	• Critical path • Reducing spanning problem • Maximum flow • Planning projects and critical path	• Uses critical path and maximum flow in a project	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	• Introduction : By solution of two simultaneous equations with two unknowns.	• $\begin{vmatrix} a & b \\ p & q \end{vmatrix} = -\begin{vmatrix} p & q \\ a & b \end{vmatrix}$	04
	8.1 Solve equations by using two or three variable	• Properties ú Interchange of two rows or two columns changes the sign of the determinant ú If two rows or two columns of a determinant are identical the determinant becomes zero ú 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 its following $\begin{pmatrix} a & b \\ p & q \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} = \frac{c}{r}$ $\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} a & b \\ p & q \end{pmatrix}\begin{pmatrix} e \\ r \end{pmatrix}$	06

Competency	Competency Level	Contents	Learning outcomes	No. of Periods
9. Manipulates Matrix Algebra	9.1 Describes Matrix Algebra	• Definition and notation of of matrices • Elements rows, cloumns size of Matrix row matrix column matrix. • Matrix addition ú Conformable for addition ú Commutative and associative laws for addition • Scalar multiplication • Distributive law for addition over scalar multiplication.	• 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	Matrix multiplication ú Compatibility of matrices for multiplication ú Illustrating that matrix multiplication is not commutative • Square Matrices ú Unit matrix ú Diagonal matrix	• Verifies square matrices by using the definition • 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
		• Algebra of square matrices ú Associativity of maxtrix multiplication (AB)C=A(BC) ú Distributivity of matrix multiplication over addition A (B + C) = AB + AC (B + C) A = BA + CA ú IA = A = AI, where I is the unit matrix of order same as A ú When $f(x)$ is a polynomial in x computation of $f(A)$ • Transpose. $(A+B)^T = A^T + B^T$ $(A^T)^T = A$ $(kA)^T = kA^T$, Where k is a scalar. $(AB)^T = B^T A^T$	• 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 tranpose of a matrix and verifies all properties regarding transpose	

7.0 TEACHING LEARNING STRATEGIES

To facilitate the students to achieve the anticipated outcome of this course, a variety of teaching stategies 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 numerial, 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 in influenced by many factors, each of which needs to be considered in determining the most appropriate teaching strategies. Research suggests that the cltural 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

8.0 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 childern.

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 activites 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 ists 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.

9.0 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
$\{x_1, x_2 \ldots\}$	the set with elements $x_1, x_2 \ldots$
$\{x \mid \ldots\}$ or $\{x : \ldots\}$	the set of all x such that...
$n(\mathrm{A})$	the number of elements in set A
$\varnothing$	empty set
ξ	universal set
A'	the complement of the set A
$\mathbb{N}$	the set of natural numbers, $\{1, 2, 3, \ldots\}$
$\mathbb{Z}$	the set of integers $\{0, \pm 1, \pm 2, \pm 3, \ldots\}$
$\mathbb{Z}^+$	the set of positive integers $\{1, 2, 3, \ldots\}$
$\mathbb{Q}$	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
M	not subset
$\not\subset$	not a proper subset
$\cup$	union
$\cap$	intersection
$[a,b]$	the colsed interval $\{x \in R : a \le x \le b\}$
$(a,b]$	the interval $\{x \in R : a < x \le b\}$
$[a,b)$	the interval $\{x \in R : a \le x < b\}$
(a,b)	the open interval $\{x \in R : a < x < b\}$

2. Miscellaneous Symbols

$=$	equal
$\neq$	not equal
$\equiv$	identical or congruent
$\approx$	approximately equal
$\propto$	proportional
$<$	less than
$\le$	less than or equal
$>$	greater than
$\ge$	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 multipllied by b
$a \div b$, $\frac{a}{b}$	a divided by b
$a:b$	the ratio between a and b
$\sum_{i=1}^{n} a_i$	$a_1 + a_2 + \ldots + a_n$
$\sqrt{a}$	the positive square root of the real number a
$\lvert a \rvert$	the modulus of the real number a
$n!$	n factorial for $n \in \mathbb{Z}^+ \cup \{0\}$
$^nP_r = \frac{n!}{(n-r)!}$ $0 \le r \le n$	$n \in \mathbb{Z}^+$, $r \in \mathbb{Z}^+ \cup \{0\}$
$^nC_r = \frac{n!}{r!(n-r)!}, 0 \le r \le n$	$n \in \mathbb{Z}^+$, $r \in \mathbb{Z}^+ \cup \{0\}$

4. Functions

$f(x)$	the functin f of x
$f: A \to B$	f is a function under which each element of set A has an Image in set B
$f: x \to y$	the function f maps the element x to the elementy
f^{-1}	the inverse the function f
$g \circ f$	the composite function of f and g which is defined by $g \circ f(x)$
$\lim_{x \to a} f(x)$	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
$f^{(1)}(x),\ f^{(2)}(x),\ \ldots,\ f^{(n)}(x)$	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 $a \le x \le b$
$\dot{x},\ \ddot{x},\ \ldots$	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

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

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
$P(A \times B)$	probability of the event A given the event B
X, Y, R, ...	random variables
x, y, r, ... ect.	values of the random variables X, Y, R etc.
$x_1, x_2, \ldots$	observations
$f_1, f_2, \ldots$	frequencies with which the observations $x_1, x_2, \ldots$ occur

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

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

$\bar{x}$	Mean
σ^2	Variance
σ / S / SD	Standard deviation

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
$P(A \times B)$	probability of the event A given that event B is happened
X, Y, R, ...	random variables
x, y, r, ... ect.	values of the random variables X, Y, R etc.
$x_1, x_2, \ldots$	observations
$f_1, f_2, \ldots$	frequencies with which the observations $x_1, x_2, \ldots$ occur

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

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

$\overline{x}$	arithmetic mean
σ^2	variance
σ / S / SD	standard deviation