آغا خان یونیورسٹی ایگزامینیشن بورڈ

AGA KHAN UNIVERSITY EXAMINATION BOARD

Higher Secondary School Certificate Examination Syllabus

MATHEMATICS

CLASSES XI-XII

(based on National Curriculum 2006)

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Higher Secondary School Certificate Examination Syllabus

MATHEMATICS

CLASSES XI-XII

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PREFACE

In pursuance of National Education Policy (1998-2010), the Curriculum Wing of the Federal Ministry of Education has begun a process of curriculum reform to improve the quality of education through curriculum revision and textbook development (Preface, National Curriculum documents 2000 and 2002).

AKU-EB was founded in August 2003 with the same aim of improving the quality of education nationwide. As befits an examination board it seeks to reinforce the National Curriculum revision through the development of appropriate examinations for the Secondary School Certificate (SSC) and Higher Secondary School Certificate (HSSC) based on the latest National Curriculum and subject syllabus guidance.

AKU-EB has a mandate by Ordinance CXIV of 2002 to offer such examination services to English and Urdu medium candidates for SSC and HSSC from private schools anywhere in Pakistan or abroad, and from government schools with the relevant permissions. It has been accorded this mandate to introduce a choice of examination and associated educational approach for schools, thus fulfilling a key objective of the National Curriculum of Pakistan: "Autonomy will be given to the Examination Boards and Research and Development cells will be established in each Board to improve the system" (ibid. para. 6.5.3 (ii)).

AKU-EB is committed to creating continuity of educational experience and the best possible opportunities for its students. In consequence it offered HSSC for the first time in September, 2007 to coincide with the arrival of its first SSC students in college or higher secondary school. Needless to say this is not an exclusive offer. Private candidates and students joining AKU-EB affiliated schools and colleges for HSSC Part 1 are eligible to register as AKU-EB candidates even though they have not hitherto been associated with AKU-EB.

This examination syllabus exemplifies AKU-EB's commitment to national educational goals.

- It is in large part a reproduction, with some elaboration, of the Class XI and XII National Curriculum of the subject.

- It makes the National Curriculum freely available to the general public.

- The syllabus recommends a range of suitable textbooks already in print for student purchase and additional texts for the school library.

- It identifies areas where teachers should work together to generate classroom activities and materials for their students as a step towards the introduction of multiple textbooks, another of the Ministry of Education's policy provisions for the improvement of higher secondary education (ibid. para. 6.3.4).

This examination syllabus brings together all those cognitive outcomes of the National Curriculum statement which can be reliably and validly assessed. While the focus is on the cognitive domain, particular emphasis is given to the application of knowledge and understanding, a fundamental activity in fostering "attitudes befitting useful and peaceful citizens and the skills for and commitment to lifelong learning which is the cornerstone of

national economic development" (Preface to National Curriculum documents 2000 and 2002).

To achieve this end AKU-EB has brought together university academicians, teacher trainers, writers of learning materials and above all, experienced teachers, in regular workshops and subject panel meetings.

AKU-EB provides copies of the examination syllabus to subject teachers in affiliated schools to help them in planning their teaching. It is the syllabus, not the prescribed textbook which is the basis of AKU-EB examinations. In addition, the AKU-EB examination syllabus can be used to identify the training needs of subject teachers and to develop learning support materials for students. Involving classroom teachers in these activities is an important part of the AKU-EB strategy for improving the quality of learning in schools.

The Curriculum Wing of the Federal Ministry of Education has recently released new subject specifications and schemes of study to take effect in September, 2008. These documents are a major step forward towards a standards-related curriculum and have been welcomed by AKU-EB. Our current HSSC syllabuses have been revised to ensure conformity with the new National Curriculum 2006.

We stand committed to all students who have embarked upon the HSSC courses in facilitating their learning outcomes. Our examination syllabus document ensures all possible support.

Dr. Thomas Christie
Director,
Aga Khan University Examination Board
July 2009

1. Aims/Objectives of the National Curriculum (2000)[1]

The objectives of teaching Mathematics at the secondary level given in the National Curriculum document (2000) are as follows:

1.1 "To enable students to acquire understanding of concepts of Mathematics and apply them to the problems of the world they live in.

1.2 To provide the students with a sound basis for specialization in Mathematics at higher stages or to apply it in scientific and technical fields.

1.3 To enable the students to reason consistently, to draw correct conclusions for given hypotheses; and to inculcate in them a habit of examining any situation critically and analytically.

1.4 To enable the students to communicate their thoughts through symbolic expressions and graphs.

1.5 To develop sense of distinction between relevant and irrelevant data.

1.6 To give the students basic understanding and awareness of the power of Mathematics in generalization and abstraction.

1.7 To foster in students the spirit of exploration and discovery."

2. Rationale of the AKU-EB Examination Syllabus

2.1 General Rationale

2.1.1 In 2007, the Curriculum Wing of the Federal Ministry of Education (MoE) issued a revised part-wise Scheme of Studies according to which the total marks for the HSSC examination are 1100 from the year 2008 and onwards. All subjects are to be taught and examined in both classes XI and XII. It is therefore important for teachers, students, parents and other stakeholders to know:

(a) that the AKU-EB Scheme of Studies for its HSSC examination (Annex A) derives directly from the 2007 Ministry of Education Scheme of Studies;
(b) which topics will be examined in Class XI and in Class XII;
(c) at which cognitive level or levels (Knowledge, Understanding, Application and other higher order skills) the topics and sub-topics will be taught and examined;

[1] Government of Pakistan (2000), *National Curriculum; Mathematics Classes XI-XII, Islamabad,* Ministry of Education (Curriculum Wing)

2.1.2 This AKU-EB examination syllabus addresses these concerns. Without such guidance teachers and students have little option other than following a single textbook to prepare for an external examination. The result is a culture of rote memorization as the preferred method of examination preparation. The pedagogically desirable objectives of the National Curriculum which encourage "observation, creativity and other higher order thinking [skills]" are generally ignored. AKU-EB recommends that teachers and students use multiple teaching-learning resources for achieving the specific objectives of the National Curriculum reproduced in the AKU-EB examination syllabuses.

2.1.3 The AKU-EB examination syllabuses use a uniform layout for all subjects to make them easier for teachers to follow. Blank sheets are provided in each syllabus for writing notes on potential lesson plans. It is expected that this arrangement will also be found helpful by teachers in developing classroom assessments as well as by question setters preparing material for the AKU-EB external examinations. The AKU-EB aims to enhance the quality of education through improved classroom practices and improved examinations.

2.1.4 The Student Learning Outcomes (SLOs) in Section 3 start with command words such as list, describe, relate, explain, etc. The purpose of the command words is to direct the attention of teachers and students to specific tasks that candidates following the AKU-EB examination syllabuses are expected to undertake in the course of their subject studies. The examination questions will be framed using the same command words, but not necessarily the same content, to elicit evidence of these competencies in candidates' responses. The definitions of command words used in this syllabus are given in Section 8. It is hoped that teachers will find these definitions useful in planning their lessons and classroom assessments.

2.1.5 The AKU-EB has classified SLOs under the three cognitive levels Knowledge (K), Understanding (U) and Application of knowledge and skills (A) in order to derive multiple choice questions and constructed response questions on a rational basis from the subject syllabuses ensuring that the intentions of the National Curriculum should be met in full. The weighting of marks to the Multiple Choice and Constructed Response Papers is also derived from the SLOs, command words and cognitive levels. In effect the SLOs derived from the National Curriculum determine the structure of the AKU-EB subject examination set out in Section 4 and 5.

2.1.6 Some topics from the National Curriculum have been elaborated and enriched for better understanding of the subject and/or to better meet the needs of students in the twenty-first century. These additional topics have been italicized in Section 3 of this syllabus.

2.2. Specific Rationale of the AKU-EB Mathematics Examination Syllabus

2.2.1 The teaching of Mathematics at secondary level should focus on improving mathematical skills and logical thinking to enable the students to keep pace with the growing demands of science and technology and the related fields.

2.2.2 The current National Curriculum covers a wide array of topics that need to be looked at critically and give more time for deeper conceptual understanding of Mathematics. The mismatch in content weight has been balanced by allocating marks for each cognitive level e.g. Knowledge, Understanding and Application. This guidance will help both teachers and students to prepare for the AKU-EB examination leading to increased student achievements.

2.2.3 While the National Curriculum provides a framework for the subject areas, the AKU-EB syllabuses specifically outlines learning objectives for making classroom practices more effective. In order to bring the use of mathematics more closely in line with every day life and to avoid rote learning, students should not be assessed on reproducing theorems. Rather they will be assessed on the application of these theorems.

3. Topics and Student Learning Outcomes of the Examination Syllabus

Part I (Class XI)

Topics		Student Learning Outcomes		Cognitive Level[2]		
				K	U	A
1. Complex Numbers		**Candidates should be able to:**				
	1.1 Complex Numbers	1.1.1	write complex number z represented by an expression of the form $z = a + ib$ or of the form (a, b) where a and b are real numbers and $i = \sqrt{-1}$;	*		
		1.1.2	recognize a as real part and b as imaginary part of $z=a+ib$;	*		
		1.1.3	write the condition for equality of complex numbers;		*	
		1.1.4	perform four basic operations (addition, subtraction, multiplication and division) on complex numbers;			*
		1.1.5	define and find $\overline{z} = a - ib$ as the complex conjugate of $z = a + ib$;			*
		1.1.6	define and calculate $\lvert z\rvert = \sqrt{a^2 + b^2}$ as the absolute value or modulus of a complex number $z = a + ib$;			*
	1.2 Properties of Complex Numbers	1.2.1	describe and identify properties of complex numbers (commutative, associative and distributive with respect to addition and multiplication);	*		
		1.2.2	find additive inverse and multiplicative inverse of a complex number *;*			*
		1.2.3	prove the following properties			
			(i) $\lvert z\rvert = \lvert -z\rvert = \lvert\overline{z}\rvert = \lvert -\overline{z}\rvert$		*	
			(ii) $\overline{\overline{z}} = z$, $z\overline{z} = \lvert z\rvert^2$, $\overline{z_1 \pm z_2} = \overline{z_1} \pm \overline{z_2}$,			
			(iii) $\overline{z_1 z_2} = \overline{z_1}\ \overline{z_2}$, $\overline{\left(\frac{z_1}{z_2}\right)} = \frac{\overline{z_1}}{\overline{z_2}}$, $z_2 \neq 0$			

[2] K = Knowledge, U = Understanding, A= Application (for explanation see section 8: Definition of command words used in Student Learning Outcomes and in Examination Questions).

NOTES

			K	U	A
	1.2.4	find real and imaginary parts of the following type of complex numbers; i. $(x+iy)^n$ ii. $\left(\frac{x_1+iy_1}{x_2+iy_2}\right)^n$; $x_2+iy_2 \neq 0$ where $n = \pm 1$ and $n = \pm 2$;			*
1.3 Solution of Equations	1.3.1	solve the simultaneous linear equations with complex coefficients;			*
	1.3.2	factorize the polynomial *P (x)*, For example; $x^2+y^2=(x+iy)(x-iy)$ $x^3-3x^2+x+5=(x+1)(x-2-i)(x-2+i)$			*
	1.3.3	solve quadratic equation of the form $pz^2+qz+r=0$; $p \neq 0$ by completing square, where *p*, *q*, *r* are real numbers and *z* is a complex number;			*
2. Matrices and Determinants	**Candidates should be able to:**				
2.1 Matrices	2.1.1	recall the concept of (i) a matrix and its notation, (ii) order of a matrix, (iii) equality of two matrices;	*	*	
	2.1.2	define and write row matrix, column matrix, square matrix, rectangular matrix, zero/null matrix, identity matrix, scalar matrix, diagonal matrix;		*	
	2.1.3	define upper and lower triangular matrix, transpose of a matrix, symmetric matrix and skew-symmetric matrix;	*	*	

NOTES

			K	U	A
2.2 Algebra of Matrices	2.2.1	perform scalar multiplication, addition and subtraction of matrices;			*
	2.2.2	perform multiplication of two or more matrices having real and complex entries;			*
	2.2.3	show that commutative property in matrices; (i) holds under addition (ii) does not hold under multiplication, in general		*	
	2.2.4	verify that $(AB)^t = B^t A^t$ *(for specific cases up to order 3 by 3)*		*	
2.3 Determinants and Inverse Matrices	2.3.1	describe and find determinant of a square matrix;		*	
	2.3.2	find minor and cofactor of an element of a square matrix of order 3 by 3;			*
	2.3.3	define singular and non-singular matrices and solve related problems;			*
	2.3.4	find the adjoint of a square matrix of order 3 by 3;			*
	2.3.5	find the inverse of a square matrix by using adjoint method;		*	*
	2.3.6	verify the result $(AB)^{-1} = B^{-1}A^{-1}$; *(for specific cases up to order 3 by 3)*		*	
2.4 Properties of Determinants	2.4.1	state and verify the properties of determinants;		*	
	2.4.2	evaluate the determinant without expansion (using properties of determinants);			*
2.5 Row and Column Operations	2.5.1	apply the row and column operations on matrices;			*
	2.5.2	define Echelon and Reduced Echelon form of a matrix;	*		*
	2.5.3	reduce a matrix of order 3 to its echelon and reduced echelon form;		*	*
	2.5.4	define the rank of a matrix;	*	*	
	2.5.5	apply row operations to find the inverse and the rank of a matrix;			*

NOTES

			K	U	A
2.6 System of Linear Equations	2.6.1	distinguish between homogeneous and non-homogeneous linear equations in two and three unknowns;	*		
	2.6.2	solve a system of three homogeneous linear equations in three unknowns;			*
	2.6.3	define and demonstrate through examples a consistent and inconsistent system of linear equations;			*
	2.6.4	solve a system of 3 by 3 non-homogeneous linear equations using: (i) matrix inversion method; (ii) Gauss elimination method (echelon form); (iii) Gauss-Jordan method (reduced echelon form); (iv) Cramer's rule;			*
3. Sequences and series	**Candidates should be able to:**				
3.1 Sequence	3.1.1	define and write a sequence (progression) and its terms;	*	*	
	3.1.2	derive the general term of a sequence;		*	
	3.1.3	identify and differentiate triangular, factorial and Pascal sequences;		*	
3.2 Arithmetic Sequence	3.2.1	define, write and identify an arithmetic sequence;	*	*	
	3.2.2	derive the formula of n^{th} or general term of an arithmetic sequence and apply the formula;		*	*
	3.2.3	solve problems involving arithmetic sequence;			*
3.3 Arithmetic Mean	3.3.1	find the arithmetic mean between two numbers;		*	
	3.3.2	insert '*n*' arithmetic means between two numbers;			*
3.4 Arithmetic Series	3.4.1	define and recognize arithmetic series;	*	*	
	3.4.2	derive the formula to find the sum to *n* terms of an arithmetic series;		*	
	3.4.3	solve problems involving arithmetic series;			*

NOTES

			K	U	A
3.5 Geometric Sequence	3.5.1	define, write and recognize geometric sequence;	*	*	
	3.5.2	derive the formula of n^{th} or general term of an geometric sequence and apply the formula;		*	
	3.5.3	solve problems involving geometric sequence;			*
3.6 Geometric Mean	3.6.1	find the geometric mean between two numbers;		*	
	3.6.2	insert '*n*' geometric means between two numbers;			*
3.7 Geometric Series	3.7.1	define, write and recognize a geometric series;		*	
	3.7.2	find the sum of *n* terms of a geometric series;		*	
	3.7.3	find the sum of an infinite geometric series;		*	
	3.7.4	convert the recurring decimal into an equivalent common fraction;			*
	3.7.5	solve problems involving geometric series;			*
3.8 Harmonic Sequence	3.8.1	define, write and recognize harmonic sequence;	*	*	
	3.8.2	find n^{th} term of harmonic sequence;		*	*
3.9 Harmonic Mean	3.9.1	calculate a harmonic mean between two numbers;	*		*
	3.9.2	describe and insert *n* harmonic means between two numbers;		*	*
	3.9.3	define and calculate relation between arithmetic, geometric and harmonic means;	*	*	*
4. Miscellaneous Series	**Candidates should be able to:**				
4.1 Evaluation of $\sum n, \sum n^2 and \sum n^3$	4.1.1	recognize $\sum$ (sigma) notation to denote the sum;		*	
	4.1.2	find the sum of;			*
		(i) the first *n* natural numbers ($\sum n$);			
		(ii) the squares of the first *n* natural numbers ($\sum n^2$);			
		(iii) the cubes of the first *n* natural numbers ($\sum n^3$);			
	4.1.3	*solve problems involving* ($\sum n$),($\sum n^2$),($\sum n^3$)			*

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4.2 Arithmetico-Geometric Series	4.2.1	define and recognize arithmetico -geometric series;		*	
	4.2.2	find sum to *n* terms of the arithmetico-geometric series;		*	
4.3 Method of Differences	4.3.1	describe and apply method of differences;		*	
	4.3.2	find the sum of *n* terms of the series whose differences of the consecutive terms are either in arithmetic or in geometric sequence;			*
5. Permutation, Combination and probability	**Candidates should be able to:**				
5.1 Factorial of a Natural Number	5.1.1	write product of first *n* natural numbers by *n!* (Kramp's factorial); *recognize and apply the fact 0! =1*;		*	
5.2 Counting Techniques (Fundamental principle of Counting, Permutation and Combination)	5.2.1	recognize and apply the fundamental principle of counting in different situations		*	*
	5.2.2	illustrate the fundamental principle of counting using tree diagram;		*	
	5.2.3	explain the meaning of permutation of *n* different objects taken *r* at a time and recognize the notation ${}^{n}P_{r}$		*	
	5.2.4	prove that $${}^{n}P_{r} = \frac{n!}{(n-r)!}$$ $${}^{n}P_{n} = n!$$		*	
	5.2.5	apply ${}^{n}P_{r}$ to solve relevant problems;			*
	5.2.6	find the arrangement of different objects around a circle;			*
	5.2.7	explain the meaning of combination of *n* different objects taken *r* at a time and recognize the notation ${}^{n}C_{r}$		*	

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	5.2.8	prove that (i) ${}^{n}c_{r} = \binom{n}{r} = \frac{n!}{r!(n-r)!}$ (ii) $\binom{n}{n} = \binom{n}{0} = 1,$ (iii) $\binom{n}{r} = \binom{n}{n-r}, \binom{n}{1} = \binom{n}{n-1} = n$ (iv) $\binom{n}{r} + \binom{n}{r-1} = \binom{n+1}{r}.$		*	
	5.2.9	solve problems involving combination;			*
5.3 Probability	5.3.1	define and describe the following terms • statistical experiment; • sample space and an event; • mutually exclusive and mutually inclusive (non-exclusive) events; • equally likely events; • dependent and independent events; • simple and compound events;	*	*	

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	5.3.2	apply the formula for probability of occurrence of an event *E*, that is $P(E) = \frac{n(E)}{n(S)}, 0 \le P(E) \le 1$;			*
	5.3.3	apply the formula for finding probability in simple cases;		*	*
	5.3.4	apply Venn diagrams and tree diagrams to find the probability for the occurrence of an event;			*
	5.3.5	define the conditional probability;		*	
	5.3.6	recognize and comprehend the law of addition of probability; $P(A \cup B) = P(A) + P(B) - P(A \cap B)$, where A and B are two non exclusive events;		*	
	5.3.7	deduce that $P(A \cup B) = P(A) + P(B)$ where A and B are mutually exclusive events;		*	
	5.3.8	recognize and comprehend the law of multiplication of probability; i. $P(A \cap B) = P(A) \times P(B \mid A)$ OR $P(A \cap B) = P(B) \times P(A \mid B)$ where P(B|A) and P(A|B) are conditional probabilities and A and B are dependent events; ii. deduce that $P(A \cap B) = P(A) \times P(B)$ where A and B are independent events;		*	
	5.3.9	apply the law of addition and multiplication of probability to solve related problems;			*
6. Mathematical Induction and Binomial	**Candidates should be able to:**				
6.1 Mathematical Induction	6.1.1	comprehend the principle of mathematical induction;		*	
	6.1.2	apply the principle of mathematical induction to prove the statements, identities and formulae;			*

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6.2 Binomial Theorem	6.2.1	apply Pascal's triangle to find the expansion of $(x+y)^n$ where n is a small positive integer;		*	*
	6.2.2	state and prove binomial theorem for positive integral index;		*	
	6.2.3	expand $(x+y)^n$ using binomial theorem and find its general term;			*
	6.2.4	find the specified term in the expansion of $(x+y)^n$;			*
6.3 Binomial Series	6.3.1	expand $(1+x)^n$ where n is a positive integer and extend this result for all rational values of n;		*	
	6.3.2	expand $(1+x)^n$ in ascending powers of x and explain its convergence for $\|x\|<1$ where n is a rational number;			*
	6.3.3	determine the approximate values of the binomial expansions having indices as negative integers or fractions.			*
	6.3.4	determine the first negative term in the binomial expansion of $(x+y)^n$, when n is a non-integral rational number.		*	*
7. Quadratic Equations	**Candidates should be able to:**				
7.0 Revision of the work done in previous classes (Exercise)	7.0.1	describe and write quadratic equation in standard form;	*	*	
	7.0.2	solve a quadratic equation in one variable by; a) factorization method b) completing square method c) using quadratic formula		*	

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7.1	Solution of Equation Reducible to Quadratic Equation in one Variable (Examples and Exercises)	7.1.1	solve equations reducible to quadratic equation in one variable such as i. $ax^{2n} + bx^n + c = 0, \quad a \neq 0$ ii. $(x+a)(x+b)(x+c)(x+d) = k, \ where\, a+b = c+d$ iii. exponential equations(in which the variables occur in exponents e.g. $a^{2x} - b.a^{x+2} + k = 0$) iv. reciprocal equations[$a(x^2 + \frac{1}{x^2}) + b(x + \frac{1}{x}) + c = 0$] v. radical equations; (check extraneous roots if any by substitution) a. $l(ax^2 + bx) + m\sqrt{ax^2 + bx + c} = 0$ b. $\sqrt{x+a} + \sqrt{x+b} = \sqrt{x+c}$ c. $\sqrt{ax^2 + bx + c} + \sqrt{px^2 + qx + r} = \sqrt{lx^2 + mx + n}$ (where $ax^2 + bx + c$, $px^2 + qx + r$ and $lx^2 + mx + n$ have a common factor) d. $\sqrt{ax^2 + bx + c} + \sqrt{px^2 + qx + r} = mx + n$ {where $(mx + n)$ is a factor of $(ax^2 + bx + c) - (px^2 + qx + r)$ }		*	*
7.2	Nature of the Roots of a Quadratic Equation	7.2.1	define and calculate discriminant $(b^2 - 4ac)$ of the quadratic equation $ax^2 + bx + c = 0;\ a \neq 0$;	*	*	
		7.2.2	discuss the nature of roots of a quadratic equation through discriminant;		*	
		7.2.3	determine the nature of roots of a given quadratic equation and verify the result by solving the equation;		*	*
7.3	Cube Roots of Unity and their properties	7.3.1	find cube roots of unity and other numbers (e.g. $\pm 8, \pm 27$ etc), recognize complex cube roots of unity i.e. ω and ω^2, prove the properties of cube roots of unity, apply properties of cube roots of unity to solve problems;		*	*
		7.3.2	find fourth roots of unity, describe and write the properties of fourth roots of unity		*	

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7.4	Roots and coefficient of a quadratic equation	7.4.1	find the relation between the roots and the coefficient of a quadratic equation, find the sum and product of roots of a given quadratic equation without solving it, solving problems based on the sum and product of roots;		*	*
		7.4.2	find a quadratic equation whose roots are given;			*
		7.4.3	find the value(s) of unknown(s) involved in a given quadratic equation when • sum of roots is equal to the product of roots; • sum of the squares of roots is equal to a given number; • roots differ by a given number; • roots satisfy a given relation (e.g. the relation $2\alpha + 5\beta = 7$ and $\alpha = \beta$, where α and β are the roots of given equation); • both sum and product of roots are equal to a given number;		*	*
7.5	Formation of quadratic equation	7.5.1	establish the formula $x^2 - (\text{sum of roots})\,x + (\text{product of roots}) = 0$ to find a quadratic equation from the given roots;	*	*	
		7.5.2	form a quadratic equation whose roots, for example, are : • $2\alpha+1, 2\beta+1$ • α^2, β^2 • $\frac{1}{\alpha}, \frac{1}{\beta}$, • $\frac{\alpha}{\beta}, \frac{\beta}{\alpha}$, • $\alpha+\beta, \frac{1}{\alpha}+\frac{1}{\beta}$ • α^3, β^3 etc.; where α and β are the roots of a given quadratic equation ;		*	*

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7.6 Synthetic division	7.6.1	describe and apply remainder theorem and factor theorem;	*	*	*
	7.6.2	apply synthetic division to • find quotient and remainder when a given polynomial is divided by a linear polynomial; • find the value(s) of unknown(s) if the factors of a polynomial are given; • solve a cubic equation if one root of the equation is given; • solve a bi-quadratic (quatric) equation if two of the real roots of the equation are given;		*	*
7.7 Simultaneous Equations	7.7.1	solve a system of two equation in two variables when • One equation is linear and the other is quadratic; • Both the equations are quadratic;		*	*
7.8 Applications of quadratic equations	7.8.1	solve word problems related to quadratic equations;			*
8. Functions and their Graphs	**Candidates should be able to:**				
8.1 Function	8.1.1	describe function as a rule of correspondence, define and write domain, co-domain and range of a function, one to one and onto functions;	*	*	
	8.1.2	define and differentiate between even and odd functions;	*	*	
	8.1.3	distinguish between linear, quadratic and square root functions;	*	*	
8.2 Inverse Function	8.2.1	define and describe inverse functions and illustrate their domain and range with examples;	*	*	*

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			K	U	A
9. Linear Programming	**Candidates should be able to:**				
9.1 Introduction	9.1.1	define and explain terms used in the linear programming;	*		
	9.1.2	describe linear programming (LP) as a planning of allocation of limited resources to obtain an optimal result;		*	
9.2 Linear Inequalities	9.2.1	recall algebraic solutions of linear inequalities in one variable and represent them on number line;		*	
	9.2.2	draw and interpret graphically the linear inequalities in two variables;			*
	9.2.3	determine graphically the region bounded by at most 3 simultaneous linear inequalities of non-negative variables and shade the region bounded by them;			*
9.3 Feasible Region	9.3.1	define and describe • linear programming problem; • objective function; • problem constraints; • decision variables;	*	*	
	9.3.2	describe and illustrate graphically the feasible region (or solution space) of a LP problem;	*	*	
	9.3.3	identify and shade the feasible region of LP problems;			*
9.4 Optimal Solution	9.4.1	define optimal solution of a LP problem;	*	*	
	9.4.2	find optimal solution (graphical) through the following systematic procedure to establish the mathematical formulation of LP problem; i. construct the graph ii. identify the feasible region iii. locate the solution points iv. evaluate the objective function v. select the optimal solution vi. verify the optimal solution by actually substituting values of variables from the feasible region;		*	*
	9.4.3	solve simple LP problems;			*

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10. Trigonometric Identities of Sum and Difference of Angles	**Candidates should be able to:**				
	10.1.1	*derive and apply distance formula between two points*;		*	*
10.1 Fundamental Law of Trigonometry	10.1.2	apply distance formula to establish fundamental law of trigonometry; $\cos(\alpha - \beta) = \cos\alpha\cos\beta + \sin\alpha\sin\beta$ and deduce that (i) $\cos(\alpha + \beta) = \cos\alpha\cos\beta - \sin\alpha\sin\beta$ (ii) $\sin(\alpha \pm \beta) = \sin\alpha\cos\beta \pm \cos\alpha\sin\beta$ (iii) $\tan(\alpha \pm \beta) = \frac{\tan\alpha \pm \tan\beta}{1 \mp \tan\alpha\tan\beta}$		*	
	10.1.3	apply above formulae to solve related problems;		*	*
10.2 Trigonometric Ratios of Allied Angles	10.2.1	define and identify allied angles;	*	*	
	10.2.2	apply fundamental law and its deductions to derive trigonometric ratios of allied angles;		*	*
	10.2.3	express $a\sin\theta + b\cos\theta$ in the form $r\sin(\theta + \phi)$ where $a = r\cos\emptyset$ and $b = r\sin\emptyset$;		*	
10.3 Double, Half and Triple Angle Identities	10.3.1	derive double angle, half angle and triple angle identities from fundamental law and its deductions;		*	*
10.4 Sum, Difference and Product of sine and cosine	10.4.1	derive and apply the product (of sines and cosines) as sums or differences (of sines and cosines);		*	*
	10.4.2	derive and apply the sums or differences (of sines and cosines) as products (of sines and cosines);		*	*

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11. Application of Trigonometry	**Candidates should be able to:**			
11.1 Solution of Triangles	11.1.1 solve a right-angled triangle when measures of i. two sides are given; ii. one side and one angle are given;			*
	11.1.2 define an oblique triangle and prove i. the law of cosines ii. the law of sines iii. the law of tangents and deduce respective half angle formulae;	*	*	
	11.1.3 apply above laws to solve problems related to oblique triangles;			*
11.2 Area of a Triangle	11.2.1 derive and apply the formulae to find the area of a triangle when i. measures of two sides and their included angle are given; ii. measures of one side and two angles are given; iii. measures of three sides are given (Hero's formula);		*	*
11.3 Circles Connected with triangle	11.3.1 define and illustrate circum-circle, in-circle and escribed-circle;		*	
	11.3.2 derive and apply the formulae to find i. circum-radius ii. in-radius iii. escribed-radii	*	*	*
	11.3.3 apply above formulae to deduce different identities;			*

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12.	**Graphs of Trigonometric And Inverse Trigonometric Functions And Solution Of Trigonometric Equations**	**Candidates should be able to:**			
	12.1 Period of Trigonometric functions	12.1.1 find the domain and range of the trigonometric functions;		*	
		12.1.2 differentiate between even and odd trigonometric functions and discuss their graphical behaviour;	*	*	
		12.1.3 discuss the periodicity of trigonometric functions and effects of periodicity on their graphs;			*
		12.1.4 find the maximum and minimum value of a given functions of the types i. $a + b \sin\theta$, ii. $a + b \cos\theta$, iii. $a + b \sin(c\theta + d)$, iv. $a + b \cos(c\theta + d)$, and the reciprocals of above mentioned functions where a, b, c and d are real numbers;			*
	12.2 Graphs of Trigonometric	12.2.1 recognize the shapes of the graphs of sine, cosine and tangent for all angels;		*	
		12.2.2 draw the graphs of the six basic trigonometric functions within the domain from -2π to 2π;			*
		12.2.3 sketch the graphs of trigonometric functions e.g. $\sin 2\theta$, $\cos 2\theta$, $\sin\frac{\theta}{2}$, $\cos\frac{\theta}{2}$ etc;		*	
		12.2.4 define periodic, even or odd and translation properties of the graphs of $\sin\theta$, $\cos\theta$, and $\tan\theta$, for example $\sin\theta$, has: • periodic property $\sin(\theta \pm 2\pi) = \sin\theta$ • odd property $\sin(-\theta) = -\sin\theta$ • translation property $\sin(\theta - \pi) = -\sin\theta$ and $\sin(\pi - \theta) = \sin\theta$;	*		*

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12.3 Solution of Trigonometric Equation Graphically	12.3.1	solve trigonometric equations of the type $\sin\theta = k$, $\cos\theta = k$ and $\tan\theta = k$ where k is constant, using periodic, even or odd and translation properties,			*
	12.3.2	find the solutions of trigonometric equations graphically;			*
12.4 Inverse Trigonometric Function	12.4.1	describe the inverse trigonometric functions and their domain and range;	*	*	
	12.4.2	find domains and ranges of inverse trigonometric functions;			*
	12.4.3	draw the graphs of inverse trigonometric functions;		*	
	12.4.4	prove the addition and subtraction formulae of inverse trigonometric functions;		*	
	12.4.5	apply addition and subtraction formulae of inverse trigonometric functions to verify related identities;			*
12.5 Solution of General Trigonometric Equations	12.5.1	solve trigonometric equations and check their roots by substitution in the given trigonometric equations so as to discard extraneous roots to find the general solution taking in to account the period of a trigonometric function;		*	*

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Part II (Class XII)

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13. Introduction to Symbolic Package Maple	**Candidates should be able to:**			
13.1 Introduction	13.1.1 understand MAPLE integrated development environment; 13.1.2 recognize basic MAPLE commands; 13.1.3 apply MAPLE as a calculator; 13.1.4 use online MAPLE help;			
13.2 Polynomials	use MAPLE commands to; 13.2.1 make factors a polynomial 13.2.2 expand an expression 13.2.3 simplify an expression 13.2.4 simplify a rational expression 13.2.5 substitute values into an expression;			
13.3 Graphics	use MAPLE Commands to; 13.3.1 plot a two-dimensional graph; 13.3.2 demonstrate domain and range of a plot; 13.3.3 sketch parametric equations; 13.3.4 use plotting options;			
13.4 Matrices	13.4.1 recognize matrix and vector entry arrangement through MAPLE; 13.4.2 apply matrix operations; 13.4.3 compute inverse and transpose of a matrix;			

MAPLE is given zero weightage as per recommendation of ministry of education, curriculum wing. So no cognitive level is mentioned against the MAPLE commands)

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14. Functions and limits	**Candidates should be able to:**				
14.1 Revision of Basic Terms Related to Functions	14.1.1	describe the concept of function, its domain and range , value of a function for given values of a variable, dependent and independent variables;	*	*	
14.2 Functions	14.2.1	identify through graph the domain and range of function;		*	
	14.2.2	draw the graph of modulus function (e.g. $y = \|x\|$, $y = c \times \| x \pm a \| \pm b$) identify its domain and range;		*	
14.3 Composition of Functions	14.3.1	describe the composition of functions and symbol used for composition of functions;	*		
	14.3.2	find the composition of two given functions;		*	
	14.3.3	find the corresponding values of composite functions for given values of a variable;		*	
14.4 Inverse of Composition of Functions	14.4.1	define and write the inverse of composition of two given functions with examples;		*	
	14.4.2	*relate the given functions ,composite function and inverse composite function;*		*	
14.5 Types of Functions	14.5.1	define, write and differentiate between algebraic, trigonometric, inverse trigonometric, exponential, logarithmic, hyperbolic (and their identities), explicit and implicit functions, even and odd function, and parametric representation of functions;	*	*	

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14.6 Graphical Representations	14.6.1	visualize and draw the graph of		*	*
		(i) the explicitly defined functions like $y = f(x)$ where $f(x) = e^x$, $f(x) = a^x$, $f(x) = \log_a x$, $f(x) = \log_e x$ or $\ln x$;			
		(ii) the implicitly defined relations such as $x^2 + y^2 = a^2$ and $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ (vertical line test to distinguish between graph of a function and of a non function)			
		(iii) the parametric equations of functions such as $x = at^2, y = 2at$; $x = a \sec\theta$, $y = b \tan\theta$			
		(iv) the piecewise functions, for example $y = \begin{cases} x & when \quad 0 \le x < 1 \\ x - 1 & when \quad 1 \le x \le 2 \end{cases}$			
	14.6.2	use MAPLE graphic commands for two-dimensional plot of: i. an expression (or a function) ii. parameterized form of a function iii. implicit function, by restricting domain and range;			
	14.6.3	use MAPLE package plots for plotting different types of functions;			
14.7 Limit of a Function	14.7.1	identify a real number on the number line;		*	
	14.7.2	define and represent; i. open interval; ii. closed interval; iii. half open and half closed intervals, on the number line;	*	*	

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	14.7.3	explain the meaning of a phrase: i. x tends to zero $(x \to 0)$; ii. x tends to $a\,(x \to a)$; iii. x tends to infinity $(x \to \infty)$;		*	
	14.7.4	recall sequences and define limit of a sequence;	*		
	14.7.5	find the limit of a sequence whose n^{th} term is given;		*	
	14.7.6	define limit of a function;	*		
	14.7.7	state the theorems of limits for sum, difference, power, product and quotient of functions and apply these theorems to find limit;	*	*	
14.8 Important Limits	14.8.1	evaluate the limits of functions of the following types: i. $\frac{x^n - a^n}{x-a}, \frac{x-a}{\sqrt{x}-\sqrt{a}}$ when $(x \to a)$; ii. $\left(1+\frac{1}{x}\right)^x$ when $(x \to \infty)$; iii. $(1+x)^{\frac{1}{x}}, \frac{\sqrt{x+a}-\sqrt{a}}{x}, \frac{a^x-1}{x}, \frac{(1+x)^n-1}{x}$, and $\frac{\sin x}{x}$ when $(x \to 0)$;			*
	14.8.2	evaluate limits of different algebraic, exponential, logarithmic and trigonometric functions;			*
	14.8.3	use a MAPLE command *limit* to evaluate the limit of a function;			

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14.9 Continuous and Discontinuous Functions	14.9.1 define and illustrate left hand and right hand limits with examples, *decide the existence and non-existence of limit of a function*;		*	
	14.9.2 describe continuity of a function at a point and in an interval;		*	
	14.9.3 test and decide the continuity and discontinuity of a function at a point and in an interval;			*
	14.9.4 use Maple command *iscont* to test continuity of a function at a point and in a given interval.			
15. Differentiation	**Candidates should be able to:**			
15.1 Derivative of a Function	15.1.1 distinguish between independent and dependent variables;	*	*	
	15.1.2 estimate corresponding change in the dependent variable when independent variable is increased or decreased;	*	*	
	15.1.3 explain the concept of a rate of change;	*	*	
	15.1.4 *differentiate between average rate of change and instantaneous rate of change*;		*	
	15.1.5 define derivative or differential coefficient of a function as an instantaneous rate of change of dependent variable with respect to independent variable; use of various notation for derivatives;	*		
	15.1.6 Differentiate $y = x^n$, where $n \in Z$ (the set of integers) by definition (or by ab-initio or from first principles);		*	
	15.1.7 differentiate $y = (ax + b)^n$, where $n = \frac{p}{q}$ and p, q are integers such that $q \neq 0$, from first principle;		*	

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15.2 Theorems on Differentiation and their applications	15.2.1 apply the following theorems for differentiation; • the derivative of a constant is zero; • the derivative of any constant multiple of a function is equal to the product of that constant and the derivative of the function; • the derivative of a sum (or difference) of two functions is equal to the sum (or difference) of their derivatives; • the derivative of a product of two functions is equal to (the first function) ×(derivative of the second function) plus (derivative of the first function) × (the second function); • the derivative of a quotient of two functions is equal to denominator times the derivative of the numerator, minus the numerator times the derivative of the denominator, all divided by the square of the denominator;		*	*
15.3 Chain Rule	15.3.1 prove and apply that $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$ when $y = f(u)$ and $u = g(x)$;	*	*	*
	15.3.2 prove and apply that $\frac{dy}{dx} = \frac{1}{\frac{dx}{dy}}$;		*	*

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	15.3.3	apply chain rule to show that $\frac{d}{dx}\left[f\left(x\right)\right]^{n} = n\left[f\left(x\right)\right]^{n-1}\frac{d}{dx} f\left(x\right)$;		*	*
	15.3.4	find derivative of implicit function;			*
15.4 Differentiation of Trigonometric and Inverse Trigonometric Function	15.4.1	differentiate trigonometric functions by first principles;		*	*
	15.4.2	differentiate inverse trigonometric functions by using formulae;		*	*
15.5 Differentiation of Exponential and Logarithmic Functions	15.5.1	find the derivative of e^{x} and a^{x} from first principles ;		*	
	15.5.2	find the derivative of *lnx* and $\log_{a} x$ from first principles;		*	
	15.5.3	apply logarithmic differentiation to find derivative of algebraic expressions involving product, quotient and power;			*
15.6 Differentiation of Hyperbolic and Inverse Hyperbolic Functions	15.6.1	differentiate: • hyperbolic functions (sinhx, cosh x, tanh x, cosech x, sech x and coth x) • inverse hyperbolic functions ($\sinh^{-1} x, \cosh^{-1} x, \tanh^{-1} x, \cos ech^{-1} x, \sec h^{-1} x,$ and $\coth^{-1} x$).		*	*
	15.6.2	use MAPLE command *diff* to differentiate a function.			

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16. Higher Order Derivatives and Its Applications	**Candidates should be able to:**				
16.1 Higher Order Derivatives	16.1.1	find higher order derivatives of algebraic, trigonometric, exponential and logarithmic functions;			*
	16.1.2	find the second derivative of implicit, inverse trigonometric and parametric functions;			*
	16.1.3	use MAPLE command *diff* repeatedly to find higher order derivative of a function;			
16.2 Maclaurin's and Taylor's Expansion	16.2.1	state Maclaurin's and Taylor's theorems;	*		
	16.2.2	apply these theorems to expand *sinx*, *cosx*, *tanx*, a^x, e^x, $\log_a(1+x)$ and $ln(l+x)$;			*
	16.2.3	use MAPLE command *taylor* to find Taylor's expansion for a given function;			
16.3 Application of Derivatives	16.3.1	find the angle of intersection of the two curves;		*	
	16.3.2	find the equation of tangent and normal to the curve at a given point;			*
	16.3.3	interpret geometrical interpretation of derivative;			*
	16.3.4	find the point on a curve where the tangent is parallel to the given line;			*
16.4 Maxima and Minima	16.4.1	define increasing and decreasing functions;	*		
	16.4.2	describe and illustrate graphically that i. *f(x)* is increasing on *(a,b)* if $f'(x) > 0, \forall x \in (a,b)$ ii. *f(x)* is decreasing on *(a,b)* if $f'(x) < 0, \forall x \in (a,b)$ (where $f(x)$ is differentiable function on the open interval (a,b));		*	
	16.4.3	investigate a given function for extreme values;		*	*

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	16.4.4 state the second derivative rule to find the extreme values of a function at a point;	*		
	16.4.5 apply second derivative rule to examine a given function for extreme values;		*	*
	16.4.6 solve real life problems related to extreme values;			*
	16.4.7 use MAPLE command *maximize* and *minimize* to compute maximum and minimum value of a function.			
17. Partial Fraction	**Candidates should be able to:**			
17.1 *Revision*	17.1.1 recognize, write and describe proper , improper rational fractions;	*	*	
17.2 *Resolution of Fractions into Partial Fractions*	17.2.1 describe the meaning of partial fraction;		*	
	17.2.2 resolution of $\frac{P(x)}{Q(x)}$ into partial fractions when denominator $Q(x)$,has;		*	*
	i. non repeated linear factors ii. repeated linear factors iii. non repeated irreducible quadratic factors iv. repeated irreducible quadratic factors v. mixture of above mentioned cases			
18. Integration	**Candidates should be able to:**			
18.1 Introduction	18.1.1 describe: i. the concept of the integral as an accumulator(continuous sum); ii. integration as inverse process of differentiation; iii. reason of constant of integration;		*	
	18.1.2 relate simple standard integrals formula to standard differentiation formulae;	*	*	

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18.2 Rules of Integration	18.2.1	comprehend the following rules of integration. (i) $\int \frac{d}{dx}[f(x)]dx = \frac{d}{dx}\left[\int f(x)dx\right] = f(x) + c$, where c is a constant of integration; (ii) the integral of the product of a constant and a function is the product of the constant and the integral of the function; (iii) the integral of the sum of a finite number of functions is equal to the sum of their integrals;		*	
	18.2.2	apply standard differentiation formulae to prove the results for the following integrals. (i) $\int [f(x)]^n f'(x)dx$, *(ii)* $\int \frac{f'(x)}{f(x)}dx$, (iii) $\int e^{ax}[af(x) + f'(x)]dx$.			*
18.3 Integration by Substitution	18.3.1	comprehend the method of integration by substitution;	*	*	
	18.3.2	apply method of substitution to evaluate indefinite integrals;			*

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	18.3.3	apply method of substitution to evaluate integrals of the following types: (i) $\int \frac{dx}{a^2 - x^2}$, $\int \sqrt{a^2 - x^2}\,dx$, $\int \frac{dx}{\sqrt{a^2 - x^2}}$, (ii) $\int \frac{dx}{a^2 + x^2}$, $\int \sqrt{a^2 + x^2}\,dx$, $\int \frac{dx}{\sqrt{x^2 + a^2}}$, (iii) $\int \frac{dx}{x^2 - a^2}$, $\int \sqrt{x^2 - a^2}\,dx$, $\int \frac{dx}{\sqrt{x^2 - a^2}}$, (iv) $\int \frac{dx}{ax^2 + bx + c}$, $\int \frac{dx}{\sqrt{ax^2 + bx + c}}$, (v) $\int \frac{px + q}{ax^2 + bx + c}dx$, $\int \frac{px + q}{\sqrt{ax^2 + bx + c}}dx$.			*
18.4 Integration by Parts	18.4.1	write the formula for integration by parts;	*		
	18.4.2	apply method of integration by parts to evaluate integrals of the following types: $\int \sqrt{a^2 - x^2}\,dx$, $\int \sqrt{a^2 + x^2}\,dx$, $\int \sqrt{x^2 - a^2}\,dx$;			*
	18.4.3	evaluate integrals using integration by parts;			*
18.5 Integration using Partial Fractions	18.5.1	apply partial fractions to find $\int \frac{f(x)}{g(x)}dx$, where $f(x)$ and $g(x)$ are algebraic functions such $g(x) \neq 0$.;			*

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18.6 Definite Integrals	18.6.1	define definite integral as the limit of a sum;	*		
	18.6.2	describe the fundamental theorem of integral calculus and recognize the following basic properties: • $\int_a^a f(x)dx = 0,$ • $\int_a^b f(x)dx = -\int_b^a f(x)dx,$ • $\int_a^b f(x)dx = \int_a^c f(x)dx + \int_c^b f(x)dx, a\langle c\langle b,$ • $\int_{-a}^{a} f(x)dx = \begin{cases} 2\int_0^a f(x)dx & \text{when } f(-x) = f(x) \text{ (even function)} \\ 0 & \text{when } f(-x) = -f(x) \text{ (odd function)} \end{cases};$		*	
	18.6.3	apply techniques of integration using properties to evaluate definite integrals;			*
	18.6.4	represent definite integral as the area under the curve;		*	
	18.6.5	apply definite integrals to calculate area under the curve;			*

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18.7 *Differential Equation*	18.7.1 recognize, define and write ordinary differential equation (DE), order of DE and degree of DE;	*		
	18.7.2 solve differential equations of first order and first degree by separating the variables;		*	*
	18.7.3 solve word problems (e.g. finding displacement from velocity etc);			*
	18.7.4 use MAPLE command mt to evaluate definite and indefinite integrals.			
19. Plane Analytic Geometry (Straight Line)	**Candidates should be able to:**			
19.1 Division of a Line Segment	19.1.1 derive and apply distance formula to calculate distance between two points given in Cartesian plane;	*	*	*
	19.1.2 calculate coordinates of a point that divides the line segment in given ratio (internally and externally) and apply the results in related problems;		*	*
	19.1.3 prove that the medians and angle bisectors of a triangle are concurrent;		*	
19.2 Slope of a Straight Line	19.2.1 define the slope of a line;	*		
	19.2.2 derive the formula to find the slope of a line passing through two points;		*	
	19.2.3 describe and apply the condition that two straight lines with given slopes may be; • parallel to each other • perpendicular to each other;		*	*
19.3 Equation of a Straight Line Parallel to Co-ordinate Axes	19.3.1 find the equation of a straight line parallel to; • y-axis and at a distance of a unit from it • x-axis and at a distance of b unit from it;		*	

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19.4 Standard Form of Equation of a Straight Line	19.4.1	define intercepts of a straight line;	*		
	19.4.2	derive equation of a straight line in • slope-intercept form • point-slope form • two-point form • intercepts form • normal form;		*	
	19.4.3	recall that a linear equation in two variables represents a straight line;	*		
	19.4.4	convert the general form of the equation of a straight line to the other forms;		*	*
	19.4.5	find equation of straight line by using different given condition;			*
19.5 Distance of a Point From a Line	19.5.1	recognize a point with respect to position of a line(i.e. above or below the line);		*	
	19.5.2	calculate the perpendicular distance from a point to the given straight line;			*
19.6 Angle Between Lines	19.6.1	find the angle between two coplanar intersecting straight lines;			*
	19.6.2	find the equation of family of lines passing through the point of intersection of two given lines;			*
	19.6.3	calculate angles of the triangle when the slopes of the sides are given;			*
19.7 Concurrency of Straight Lines	19.7.1	find the condition of concurrency of three straight lines;		*	*
	19.7.2	find the equation of median, altitude and right bisector of a triangle;			*
	19.7.3	show that • three right bisectors • three medians • three altitudes, of a triangle are concurrent;		*	*

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19.8 Area of a Triangular Region	19.8.1	find area of a triangular region whose vertices are given;			*
19.9 Homogenous Equation	19.9.1	recognize homogeneous linear and quadratic equations in two variables;	*		
	19.9.2	investigate that the 2nd degree homogeneous equation in two variables x and y represents a pair of straight lines through the origin and find acute angle between them;			*
20. Circles	**Candidates should be able to:**				
20.1 Introduction	20.1.1	define conics and demonstrate members of its family i.e. circle, parabola, ellipse and hyperbola;	*	*	
20.2 Circle Equation of a Circle (Standard Form)	20.2.1	define circle and related terms and derive its equation in standard form i.e. $(x-h)^2+(y-k)^2=r^2$		*	
Equation of Circle (General Form)	20.2.2	recognize general equation of a circle $x^2+y^2+2gx+2fy+c=0$ and find its centre and radius; find relation between general form and standard form;		*	
Equation of Circle Determined by a Given Condition	20.2.3	find the equation of a circle passing through; i. three non-collinear points ii. two points and having its centre on a given line iii. two points and equation of tangent at one of these points is known iv. two points and touching a given line etc;			*
	20.2.4	apply above concepts of circles to solve related problems;			*
20.3 Tangents and Normals	20.3.1	find the condition when a line intersects the circle;			*
	20.3.2	find the condition when a line touches the circle;			*
	20.3.3	find the equation of a tangent to a circle in slope form;			*
	20.3.4	find the equations of a tangent and a normal to a circle at a point ;		*	*
	20.3.5	calculate the length of tangent to a circle from a given external point;			*
	20.3.6	prove that two tangents drawn to a circle from an external point are equal in length;		*	*

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21. Parabola	**Candidates should be able to:**				
21.1 Parabola	21.1.1	define, describe and illustrate parabola and its elements (i.e. focus, directrix, eccentricity, vertex, axis, focal chord and latus rectum);	*	*	
21.2 General Form of Equation of a Parabola	21.2.1	derive the general form of an equation of a parabola;		*	
21.3 Standard Form of Equation of Parabola	21.3.1	derive the standard equations of parabola, sketch their graphs and find their elements;		*	
	21.3.2	find the equation of a parabola with the given elements, for example • focus and vertex • focus and directrix • vertex and directrix etc;			*
21.4 Equations of Tangent and Normal	21.4.1	describe the concept of tangent and normal to a parabola;		*	
	21.4.2	find the condition when a line is tangent to a parabola at a point and hence write the equation of a tangent line in slope form;			*
	21.4.3	find the equation of a tangent and a normal to a parabola at a point;			*
21.5 Application of Parabola	21.5.1	identify the role of parabola (suspension bridges, projectile etc)		*	
22. Ellipse	**Candidates should be able to:**				
22.1 Ellipse	22.1.1	describe and illustrate ellipse and its elements (i.e. centre, foci, vertices, co-vertices, directrices, major and minor axes, eccentricity, focal chord and latera recta);	*	*	
	22.1.2	explain that circle is a special case of an ellipse;		*	

NOTES

			K	U	A
22.2 Standard Form of Equation of an Ellipse	22.2.1	derive the standard form of equation of an ellipse and identify its elements;		*	
	22.2.2	find the equation of an ellipse with the given elements, for example • major and minor axes • two points • foci, vertices or lengths of a latera recta etc;			*
	22.2.3	convert a given equation to the standard form of equation of an ellipse, find its elements and draw the graph;			*
22.3 Equations of Tangent and Normal	22.3.1	describe the concept of tangent and normal to an ellipse;		*	
	22.3.2	find points of intersection of an ellipse with a line and the condition of tangency;			*
	22.3.3	find the equation of a tangent in slope form;			*
	22.3.4	find the equation of a tangent and a normal to an ellipse at a point;			*
23. Hyperbola	**Candidates should be able to:**				
23.1 Hyperbola	23.1.1	describe and illustrate hyperbola and its elements (i.e. centre, foci, vertices, directrices, transverse and conjugate axes, eccentricity, focal chord and latera recta);	*	*	
23.2 Standard form of equation of hyperbola	23.2.1	derive the standard form of equation of a hyperbola and identify its elements;		*	
	23.2.2	find the equation of a hyperbola with the given elements, for example • transverse and conjugate axes with centre at origin • eccentricity, latera recta and transverse axes • focus, eccentricity and centre • focus, centre and directrix etc;			*
	23.2.3	convert a given equation to the standard form of equation of a hyperbola, find its elements and sketch the graph;			*

NOTES

		K	U	A
23.3 Equation of tangent and normal	23.3.1 describe the concept of tangent and normal to a hyperbola; 23.3.2 find (i) points of intersection of a hyperbola with a line, including the condition of tangency (ii) the equation of a tangent in slope form; 23.3.3 find the equation of a tangent and a normal to a hyperbola at a point;		* 	 * *
24. Translation and Rotation	**Candidates should be able to:**			
24.1 Translation and Rotation of axes	24.1.1 define, describe and illustrate translation and rotation of axes with examples; 24.1.2 find the equations of transformation for • translation of axes; • rotation of axes; 24.1.3 find the transformed equation by using translation or rotation of axes; 24.1.4 find new origin and new axes referred to old origin and old axes; 24.1.5 find the angle through which the axes be rotated about the origin so that the product term *xy* is removed from the transformed equation.	* 	* 	 * * * *

NOTES

4. Scheme of Assessment

Class XI

Table 1: Number of Student Learning Outcomes by Cognitive Level

Topic No.	Topics	No. of Sub-Topics	SLOs			Total
			K	U	A	
1.	Complex Number	3	3	2	8	13
2.	Matrices and Determinants	6	5	11	14	30
3.	Sequenced and Series	9	7	18	12	37
4	Miscellaneous Series	3	0	4	3	7
5.	Permutation combination and probability	3	1	13	8	22
6.	Mathematical Induction and binomial theorem	3	0	5	7	12
7.	Quadratic Equation	8	4	15	11	30
8.	Functions and their graphs	2	4	4	1	9
9.	Linear programming	4	4	6	5	15
10.	Trigonometric identities of some and difference of angle	4	1	9	6	16
11.	Application of trigonometric	3	2	4	5	11
12.	Graph of trigonometric and inverse trigonometric functions and solution of trigonometric equations	6	3	8	9	20
	Total	**56**	**34**	**99**	**89**	**222**
	Percentage		**15**	**44**	**41**	**100**

Table 2: Allocation of Marks for the Objective Test and Constructed Response Paper

Topic No.	Topics	No. of Sub - Topics	Marks		
			Objective Test	Constructed Response Paper	Total
1.	Complex Number	3	3	4	7
2.	Matrices and Determinants	6	5	7	12
3.	Sequenced and Series	9	4	8	12
4.	Miscellaneous Series	3			
5.	Permutation combination and probability	3	4	4	8
6.	Mathematical Induction and binomial theorem	3	2	6	8
7.	Quadratic equation	8	4	7	11
8.	Function and their graph	2	1	2	3
9.	Linear programming	4	3	6	9
10.	Trigonometric identities of some and difference of angle	4	3	6	9
11.	Application of trigonometric	3	3	8	11
12.	Graph of trigonometric and inverse trigonometric functions and solution of trigonometric equations	6	3	7	10
	TOTAL	**56**	**35**	**65**	**100**

Table 3: Paper Specifications

Topic No.	Topics	Marks Distribution		Total Marks
1.	Complex Number	MCQs 3 @1 Mark CRQ 1 @ 4Marks		7
2.	Matrices and Determinants	MCQs 5 @ 1 Mark CRQ 1 @ 7 Marks		12
3.	Sequenced and Series	MCQs 4 @ 1 Mark CRQs 1 @ 5 Marks *CRQs 2 @ 3 Marks each Chose any ONE from TWO		12
4.	Miscellaneous Series			
5.	Permutation combination and probability	MCQs 4 @ 1 Mark *CRQs 2 @ 4 Marks each Chose any ONE from TWO		8
6.	Mathematical Induction and binomial theorem	MCQs 2 @ 1 Mark CRQ 1 @ 6 Marks		8
7.	Quadratic equation	MCQs 4 @ 1 Mark *CRQs 2 @ 7 Marks each Chose any ONE from TWO		11
8.	Function and their graph	MCQ 1 @ 1 Mark CRQ 1 @ 2 Marks		3
9.	Linear programming	MCQs 3 @ 1 Mark CRQ 1 @ 6 Marks		9
10.	Trigonometric identities of sum and difference of angle	MCQs 3 @ 1 Mark *CRQs 2 @ 6 Marks each Chose any ONE from TWO		9
11.	Application of trigonometry	MCQs 3 @ 1 Mark *CRQs 2 @ 8 Marks each Chose any ONE from TWO		11
12.	Graph of trigonometric and inverse trigonometric functions and solution of trigonometric equations	MCQs 3 @ 1 Mark *CRQs 2 @ 7 Marks each Chose any ONE from TWO		10
	Total	**MCQs 35**	**CRQs 65**	**100**

* There will be TWO questions and the candidates will be required to attempt any ONE by making a choice out of the TWO.

Class XII

Table 4: Number of Student Learning Outcomes by Cognitive Level

Topic No.	Topics	No. of Sub-Topics	SLOs			Total
			K	U	A	
13.	Introduction to Symbolic Package (MAPLE)	4				
14.	Functions and limits	9	7	15	4	26
15.	Differentiation	6	8	19	18	45
16.	Higher Order derivative and application	4				
17.	Partial Fractions	2	1	3	1	5
18.	Integration	7	5	7	10	22
19.	Plane analytical geometry (Straight Line)	9	5	11	14	30
20.	Circles	3	1	5	8	14
21.	Parabola	5	3	12	12	27
22.	Ellipse	3				
23.	Hyperbola	3				
24.	Translation and Rotation	1	1	1	4	6
	Total	**57**	**31**	**73**	**71**	**175**
	Percentage		**18**	**42**	**40**	**100**

Table 5: Allocation of Marks for the Objective Test and Constructed Response Paper

Topic No.	Topics	No. of Sub-Topics	Marks		
			Objective Test	Constructed Response Paper	Total
13.	Introduction to Symbolic Package (MAPLE)	4	-	-	-
14.	Functions and limits	9	5	6	11
15.	Differentiation	7	6	12	18
16.	Higher Order derivative and application	4			
17.	Partial Fractions	2	6	14	20
18.	Integration	7			
19.	Plane analytical geometry (Straight Line)	9	5	10	15
20.	Circles	3	3	7	10
21.	Parabola	5	7	12	19
22.	Ellipse	3			
23.	Hyperbola	3			
24.	Translation and Rotation	1	3	4	7
	Total	**57**	**35**	**65**	**100**

Table 6: Paper Specifications

Topic No.	Topics	Marks Distribution		Total Marks
13.	Introduction to Symbolic Package (MAPLE)	-		-
14.	Functions and limits	MCQs 5 @ 1 Mark CRQ 1 @ 6 Marks		11
15.	Differentiation	MCQs 6 @ 1 Mark CRQs 3 @ 6 Marks each Chose any TWO from THREE		18
16.	Higher Order derivative and application			
17.	Partial Fractions	MCQs 6 @ 1 Mark CRQs 3 @ 7 Marks each Chose any TWO from THREE		20
18.	Integration			
19.	Plane analytical geometry (Straight Line)	MCQs 5 @ 1 Mark CRQs 3 @ 5 Marks each Chose any TWO from THREE		15
20.	Circles	MCQs 3 @ 1 Mark CRQs 2 @ 7 Marks each Chose any ONE from TWO		10
21.	Parabola	MCQs 7 @ 1 Mark CRQs 3 @ 6 Marks each Chose any TWO from THREE		19
22.	Ellipse			
23.	Hyperbola			
24.	Translation and Rotation	MCQs 3 @ 1 Mark CRQs 2 @ 4 Marks each Chose any ONE from TWO		7
	Total	**MCQs 35**	**CRQs 65**	**100**

4.1 Tables 1 and 4 indicate the number and nature of SLOs in each topic in classes IX and X respectively. This will serve as a guide in the construction of the examination paper. It also indicates that more emphasis has been given to the Understanding (46% in XI and 38% in XII), Application and higher order skills (39% in XI and 42% in XII) to discourage rote memorization. Tables 1 and 4, however, do not translate directly into marks.

4.2 There will be two examinations, one at the end of Class XI and one at the end of Class XII.

4.3 In each class, the theory paper will be in two parts: paper I and paper II. Both papers will be administrated within 3 hours

4.4 Paper I theory will consist of 30 compulsory, multiple choice items. These questions will involve four response options.

4.5 Paper II theory will carry 45 marks and consist of a number of compulsory, constructed response questions. There will be no choice among the topics in constructed response questions but it may be within the topic.

4.6 All constructed response questions will be in a booklet which will also serve as an answer script.

5. Teaching-Learning Approaches and Classroom Activities

5.1 As the AKU-EB syllabus focuses on understanding and higher order thinking skills, teachers need to encourage activity and problem-based classroom practices.

5.2 The following strategies are recommended:

- Demonstration
- Discussion based teaching
- Inquiry approach
- Specialization/Generalization
- Problem Solving
- Seeking relationship
- Investigation
- Open-ended questions
- Presentation
- Brainstorming
- Project work
- Group discussion
- Concept building through using and developing low/no cost material
- Doing Mathematics (with teacher facilitation)

6. Recommended Texts, Reference Materials

Recommended Books

1. Punjab Textbook Board: Mathematics for Class XI and XII. Lahore: Punjab Textbook Board.
2. Sindh Textbook Board: Mathematics for Class XI and XII. Jamshoro: Sindh Textbook Board.

Reference books:

1. Cecilia A. Knoll, Michele D. Shah, Jerry Johnson, Benny Evans (1998) fifth edition. *Discovering Calculus with Mathematica* Singapore: John Wiley & Sons, INC, printed in United States of America .
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3. James Stewart, Lothar Redlin, Saleem Watson (1998) Third Edition *Precalculus mathematics for calculus* United States of America : Brooks / Cole Publishing Company.

4. Ross L.Finney and George B. Thomas JR, (1989) *Elements of Calculus and Analytic Geometry* United States of America: Addison Wesley Publishing Company.

5. Richard N. Aufman, Vernon C. Barker, Richard D. Nation, JR (1990) *Algebra and Trigonometry* Boston,USA : Printed in USA Houghton Mifflin Company.

6. Roland E Larson, Robert T. Hostetler, Anne V.Hodgkins (1996) *College Algebra Concept and Models;* Printed in USA D.C Heath & Co.

7. Eugene D. Nicolas, Mervin L.Edwards, E. Henry Garland, Sylvia A.Hoffman, Albert Mamary, William F. Palmer (1992) *holt algebra with trigonometry;* Printed in USA ,Holt ,Rinhert and Winston.INC, Harcourt Brace Jovanovich, INC.

Websites

A+Math	http://www.aplusmath.com/
AAA Math	http://www.aaamath.com/
Academic Info-Mathematics	http://www.academicinfo.net/math.html
Algebra Buster	http://www.algebra-online.com/
Algebra Helper	http://www.algebrahelp.com/index.jsp
Class Zone	http://www.classzone.com/math_middle.cfm
Click on Bricks	http://kathyschrock.net/clickonbricks/index2.htm
Cool Math	http://www.coolmath.com/
Discovery School (Mathematics)	http://school.discovery.com/lessonplans/math.html
Frank Potter's Science Gems-Mathematics	http://www.sciencegems.com/math.html
Funbrain	http://www.funbrain.com/numbers.html
Geometry	http://www.mathleague.com/help/geometry/geometry.htm
Internet Mathematics Library	http://www.mathforum.org/library
MAPLE	http://www.maplesoft.com
Math Archives	http://www.archives.math.utk.edu/
Math Glossary	http://www.harcourtschool.com/glossary/math_advantage
Math Goodies	http://www.mathgoodies.com
Math World	http://www.mathworld.wolfram.com
Math2	http://www.math2.org/
MATHEMATICA	http://www.wolfram.com/products/mathematica/index.htm
Mathematical Interactivities	http://mathematics.hellam.net/
MathStories	http://www.mathstroies.com
Mega Mathematics	http://www.c3.lanl.gov/mega-math/
Purplemath	http://www.purplemath.com/internet.htm
S.O.S. Mathematics	http://www.sosmath.com
Superkids Educational Software Review	http://www.superkids.com/aweb/tools/math/index.shtml
Teaching madeEasier	http://www.teachingmadeasier.com/math.html
The MathWorks (MATLAB)	http://www.mathworks.com
Webmath	http://www.webmath.com/

7. Definition of Cognitive Levels and Command Words in the Student Learning Outcomes in Examination Papers

7.1 Definition of Cognitive Levels (Knowledge, Understanding and Application)

Knowledge:

This requires knowing and remembering facts and figures, vocabulary and contexts, and the ability to recall key ideas, concepts, trends, sequences, categories, etc. It can be taught and evaluated through questions based on: who, when, where, what, list, define, describe, identify, label, tabulate, quote, name, state, etc.

Understanding:

This requires understanding information, grasping meaning, interpreting facts, comparing, contrasting, grouping, inferring causes/reasons, seeing patterns, organizing parts, making links, summarizing, solving, identifying motives, finding evidence, etc. It can be taught and evaluated through questions based on: why, how, show, demonstrate, paraphrase, interpret, summarize, explain, prove, identify the main idea/theme, predict, compare, differentiate, discuss, chart the course/direction, report, solve, etc.

Application:

This requires using information or concepts in new situations, solving problems, organizing information and ideas, using old ideas to create new ones, generalizing from given facts, analyzing relationships, relating knowledge from several areas, drawing conclusions, evaluating worth, etc. It can be taught and evaluated through questions based on: differentiate, analyze, show relationship, propose an alternative, prioritize, give reasons for, categorize, illustrate, corroborate, compare and contrast, create, design, formulate, integrate, rearrange, reconstruct/recreate, reorganize, predict consequences, etc.

7.2 Definition of Command Words:

Knowledge:

Define (the term or terms):	Only a formal statement or equivalent paraphrase is required. No examples need to be given.
Demonstrate:	To show by argument, facts or other evidences the validity of a statement or phenomenon.
Draw/Sketch:	To make a simple freehand sketch or diagram. Care should be taken with proportions and the clear labelling of parts.
Factorize:	To resolve or break integers or polynomials into factors.

Find: Is a general term that may variously be interpreted as calculate, measure, determine, etc.
In other contexts, describe and give an account of should be interpreted more generally, i.e. the candidate has greater discretion about the nature and the organization of the material to be included in the answer. Describe and explain may be coupled in a similar way to state and explain.

Identify: Pick out, recognizing specified information from a given content or situation.

Measure: To determine extent, quantity, amount or degree of something as determined by measurement or calculation.

Plot: To locate and mark one or more points, on a graph by means of coordinates and to draw a graph through these points.

Use: To deploy the required attribute in a constructed response.

Understand:

Arrange: To put different components in an appropriate and systematic way.

Classify: To state a basis for categorization of a set of related entities and assign examples to categories.

Compare: To list the main characteristics of two entities clearly identifying similarities (and differences).

Compute: To calculate an answer or result using different mathematical methods.

Conceptualize: To form or prove a concept through observation, experience, facts or given data.

Construct: To bring together given elements in a connected or coherent whole.

Convert: To change or adapt from one system or units to another.

Describe: To state in words (using diagrams where appropriate) the main points of the topic. It is often used with reference either to a particular phenomena or experiments. In the former instance, the term usually implies that the answer should include reference to (visual) observations associated with the phenomena.

Develop: To expand a mathematical function or expression in the form of series.

Distinguish:	To identify those characteristics which always or sometimes distinguish between two categories.
Discuss:	To give a critical account of the points involved in the topic.
Eliminate:	To remove a variable from two or more simultaneous equations.
Establish:	To prove correct or true on the basis of the previous examples.
Evaluate:	To judge or assess on the basis of facts, argument or other evidence to come to conclusion.
Explain:	To reason or use some reference to theory, depending on the context.
Express:	Use appropriate vocabulary, language structure and intonation to communicate thoughts and feelings.
Illustrate:	To give clear examples to state, clarify or synthesize a point of view.
Investigate:	Thoroughly and systematically consider a given problem or a statement in order to find out the result or rule applied.
Locate:	To determine the precise position or situation of an entity in a given context.
Present:	To write down in a logical and systematic way in order to make a conclusion or statement.
Prove:	To establish a rule or law by using an accepted sequence of procedures on statements.
Simplify:	To reduce (an equation, fraction, etc.) to a simple form by cancellation of common factors, regrouping of terms in the same variables, etc.
Solve:	To work out systematically the answer of a given problem.
Verify:	To prove, check or determine the correctness and accuracy of laws, rules or reference given in the set task.
Write:	To construct full sentences of continuous prose, not abbreviated text.

Application:

Analyse:	To go beyond using the information for relating different characteristics of the components in given material and for drawing conclusions on the basis of common characteristics.
Apply:	To use the available information in different contexts to relate and draw conclusions.
Calculate:	Is used when a numerical answer is required. In general, working should be shown, especially where two or more steps are involved.
Derive:	To arrive at a general formula by calculating step by step.
Visualize:	To form a mental image about the concept according to the facts and then write down about that image.

Annex

HSSC Scheme of Studies[3]

AKU-EB as a national board offers SSC and HSSC qualifications for both English medium and Urdu medium schools. The revised HSSC Scheme of Studies issued by the Curriculum Wing was implemented from September 2007. At the HSSC level the marks allocated to subjects are based on the revised National Scheme of Studies of 2006. The first HSSC-I part wise (Class XI) examination based on 2006 national curriculum was held in 2009 and HSSC-II (Class XII) will be held in 2010.

HSSC I-II (Classes XI-XII) subjects on offer for the examination

HSSC Part-I (Class XI) Science Group (Pre-Medical)

Subjects	Marks		
	Theory	Practical	Total
English Compulsory-I	100	-	100
Urdu Compulsory-I **OR** Pakistan Culture-I [a]	100	-	100
Physics-I	85	15	100
Chemistry-I	85	15	100
Biology-I	85	15	100
Total:	**455**	**45**	**500**

HSSC Part-II (Class XII) Science Group (Pre-Medical)

Subjects	Marks		
	Theory	Practical	Total
English Compulsory-II	100	-	100
Urdu Compulsory-II **OR** Pakistan Culture-II [a]	100	-	100
Islamiyat **OR** Ethics [b]	50	-	50
Pakistan Studies	50	-	50
Physics-II	85	15	100
Chemistry-II	85	15	100
Biology-II	85	15	100
Total:	**555**	**45**	**600**

a Foreign students may opt Pakistan Culture in lieu of Urdu Compulsory, subject to the board's approval.

b For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in both Classes XI and XII, but the examination will be conducted at the end of Class XII.

[3] Government of Pakistan September 2007 and May 2003. *Scheme of Studies for SSC and HSSC (Classes IX-XII)*, Islamabad: Ministry of Education, Curriculum Wing.

HSSC Part-I (Class XI) Science Group (Pre-Engineering)

Subjects	Marks		
	Theory	**Practical**	**Total**
English Compulsory-I	100	-	100
Urdu Compulsory-I **OR** Pakistan Culture-I [a]	100	-	100
Physics-I	85	15	100
Chemistry-I	85	15	100
Mathematics-I	100	-	100
Total:	**470**	**30**	**500**

HSSC Part-II (Class XII) Science Group (Pre-Engineering)

Subjects	Marks		
	Theory	**Practical**	**Total**
English Compulsory-II	100	-	100
Urdu Compulsory-II **OR** Pakistan Culture-II [a]	100	-	100
Islamiyat **OR** Ethics [b]	50	-	50
Pakistan Studies	50	-	50
Physics-II	85	15	100
Chemistry-II	85	15	100
Mathematics –II	100	-	100
Total:	**570**	**30**	**600**

a Foreign students may opt Pakistan Culture in lieu of Urdu Compulsory, subject to the board's approval.

b For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in both Classes XI and XII, but the examination will be conducted at the end of Class XII.

HSSC Part-I (Class XI) Science Group (Science General)

Subjects	Marks		
	Theory	**Practical**	**Total**
English Compulsory-I	100	-	100
Urdu Compulsory-I **OR** Pakistan Culture-I [a]	100	-	100
Any one subject combinations of the following:			
Physics-I	85	15	
Mathematics-I	100	-	300/
Statistics-I	85	15	
Economics-I	100	-	
Mathematics-I	100	-	300/
Statistics-I	85	15	
Economics-I	100	-	
Mathematics-I	100	-	300/
Computer Science-I	75	25	
Physics-I	85	15	
Mathematics-I	100	-	300/
Computer Science-I	75	25	
Mathematics-I	100	-	
Statistics-I	85	15	300
Computer Science-I	75	25	
Total:			**500**

HSSC Part-II (Class XII) Science Group (Science General)

Subjects	Marks		
	Theory	**Practical**	**Total**
English Compulsory-II	100	-	100
Urdu Compulsory-II **OR** Pakistan Culture-II [a]	100	-	100
Islamiyat **OR** Ethics [b]	50	-	50
Pakistan Studies	50	-	50
Any one subject combinations of the following:			
Physics-II	85	15	
Mathematics-II	100	-	300/
Statistics-II	85	15	
Economics-II	100	-	
Mathematics-II	100	-	300/
Statistics-II	85	15	
Economics-II	100	-	
Mathematics-II	100	-	300/
Computer Science-II	75	25	
Physics-II	85	15	
Mathematics-II	100	-	300/
Computer Science-II	75	25	
Mathematics-II	100	-	
Statistics-II	85	15	300
Computer Science-II	75	25	
Total:			**600**

a Foreign students may opt Pakistan Culture in lieu of Urdu Compulsory, subject to the board's approval.

b For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in both Classes XI and XII, but the examination will be conducted at the end of Class XII.

HSSC Part-I (Class XI) Commerce Group

Subjects	Marks		
	Theory	**Practical**	**Total**
English Compulsory-I	100	-	100
Urdu Compulsory-I **OR** Pakistan Culture-I [a]	100	-	100
Principles of Accounting-I	100	-	100
Principles of Economics	75	-	75
Principles of Commerce	75	-	75
Business Mathematics	50	-	50
Total:	**500**	**-**	**500**

HSSC Part-II (Class XII) Commerce Group

Subjects	Marks		
	Theory	**Practical**	**Total**
English Compulsory-II	100	-	100
Urdu Compulsory-II **OR** Pakistan Culture-II [a]	100	-	100
Islamiyat **OR** Ethics [b]	50	-	50
Pakistan Studies	50	-	50
Principles of Accounting-II	100	-	100
Commercial Geography	75		75
Computer Studies **OR** Banking	60/ 75	15 -	 75
Business Statistics	50	-	50
Total:	**600**		**600**

a Foreign students may opt Pakistan Culture in lieu of Urdu Compulsory, subject to the board's approval.

b For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in both Classes XI and XII, but the examination will be conducted at the end of Class XII.

HSSC Part-I (Class XI) Humanities Group

Subjects	Marks
English Compulsory-I	100
Urdu Compulsory-I **OR** Pakistan Culture-I [a]	100
Any three of the following Elective Subjects 1. Civics Elective-I 2. Computer Science-I (75+25 practical) 3. Economics-I 4. Education-I 5. History of Muslim India-I 6. Islamic Studies-I 7. Mathematics-I 8. Statistics-I (85+15 practical) 9. Psychology-I (85+15 practical) 10. Sociology-I 11. English Literature-I 12. Urdu Literature-I	300 (100 each)
Total:	**500**

HSSC Part-II (Class XII) Humanities Group

Subjects	Marks
English Compulsory-II	100
Urdu Compulsory-II **OR** Pakistan Culture-II [a]	100
Islamiyat **OR** Ethics [b]	50
Pakistan Studies	50
Any three of the following Elective Subjects 1. Civics Elective-II 2. Computer Science-II (75+25 practical) 3. Economics-II 4. Education-II 5. History of Muslim India-II 6. Islamic Studies-II 7. Mathematics-II 8. Statistics-II (85+15 practical) 9. Psychology-II (85+15 practical) 10. Sociology-II 11. English Literature-II 12. Urdu Literature-II	300 (100 each)
Total:	**600**

a Foreign students may opt Pakistan Culture in lieu of Urdu Compulsory, subject to the board's approval.

b For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in both Classes XI and XII, but the examination will be conducted at the end of Class XII.