



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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**MATHEMATICS  
CLASSES XI-XII**

**This subject is examined in both  
May and September Examination sessions**

<b>Sr. No.</b>	<b>Table of Contents</b>	<b>Page No.</b>
	Preface	5
1	Aims/Objectives of the National Curriculum (2006)	7
2.	Rationale of the AKU-EB Examination Syllabuses	7
3.	Topics and Student Learning Outcomes of the Examination Syllabus	10
4.	Scheme of Assessment	82
5.	Teaching-Learning Approaches and Classroom Activities	88
6.	Recommended Texts, Reference Materials and Websites	88
7.	Definition of Cognitive Levels and Command Words	90
	Annex: HSSC Scheme of Studies	93

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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)<sup>1</sup>

The objectives of teaching Mathematics 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.. 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) 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;

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<sup>1</sup> 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 or the connotation of the command words, to elicit evidence of these competencies in candidates’ responses. The definitions of command words used in this syllabus are given in Section 7. 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.



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

- 2.2.1 The teaching of Mathematics at secondary and higher 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, in order to bring the use of mathematics more closely in line with every day life and to avoid rote learning, the AKU-EB syllabuses specifically outlines learning objectives for making classroom practices more effective.

### 3. Topics and Student Learning Outcomes of the Examination Syllabus

#### Part I (Class XI)

Topics	Student Learning Outcomes		Cognitive Level <sup>2</sup>		
			K	U	A
<b>1. Complex Numbers</b>	<b>Candidates should be able to:</b>				
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	identify $a$ as real part and $b$ as imaginary part of $z = a + ib$ ;	*		
	1.1.3	describe the condition for equality of complex numbers;		*	
	1.1.4	apply four basic operations (addition, subtraction, multiplication and division) on complex numbers;			*
	1.1.5	find $\bar{z} = a - ib$ , the complex conjugate of $z = a + ib$ ;			*
	1.1.6	calculate $ z  = \sqrt{a^2 + b^2}$ , the absolute value or modulus of a complex number $z = a + ib$ ;			*
1.2 Properties of Complex Numbers	1.2.1	describe the properties of complex numbers (commutative, associative and distributive with respect to addition and multiplication);		*	
	1.2.2	find the additive inverse and multiplicative inverse of a complex number ;			*
	1.2.3	prove the following properties: i. $ z  =  -z  =  \bar{z}  =  -\bar{z} $ ii. $\overline{\bar{z}} = z$ , $z\bar{z} =  z ^2$ , $\overline{z_1 \pm z_2} = \bar{z}_1 \pm \bar{z}_2$ iii. $\overline{z_1 z_2} = \bar{z}_1 \bar{z}_2$ , $\overline{\left(\frac{z_1}{z_2}\right)} = \frac{\bar{z}_1}{\bar{z}_2}$ , $z_2 \neq 0$		*	
	1.2.4	apply the above mentioned properties to solve related problems;			*

<sup>2</sup> K = Knowledge, U = Understanding, A= Application (for explanation see section 7: Definition of command words used in Student Learning Outcomes and in Examination Questions).

**NOTES**

			K	U	A
	1.2.5	find the real and imaginary parts of the following types 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: i. $x^2 + y^2 = (x + iy)(x - iy)$ ii. $x^3 - 3x^2 + x + 5 = (x + 1)(x - 2 - i)(x - 2 + i)$ ; 1.3.3 solve quadratic equation $pz^2 + qz + r = 0$ ; $p \neq 0$ by completing the square form, where $p, q, r$ are real numbers and $z$ is a complex number;			* * *
<b>2.</b>	<b>Matrices and Determinants</b>	<b>Candidates should be able to:</b>			
2.1	Matrices	2.1.1 define the concept of: i. a matrix and its notation ii. order of a matrix iii. equality of two matrices; 2.1.2 describe row matrix, column matrix, square matrix, rectangular matrix, zero/null matrix, identity matrix, scalar matrix, diagonal matrix; 2.1.3 describe 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	apply scalar multiplication, addition and subtraction of matrices;			*
	2.2.2	apply multiplication of two or more matrices having real and complex entries;			*
	2.2.3	prove that the 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	find the determinant of a square matrix;			*
	2.3.2	find the minor and cofactor of an element of a square matrix of order 3 by 3;			*
	2.3.3	define singular and non-singular matrices ;	*		
	2.3.4	solve problems related to singular and non-singular matrices;			*
	2.3.5	find the adjoint of a square matrix of order 3 by 3;			*
	2.3.6	find the inverse of a square matrix by using adjoint method;			*
	2.3.7	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	explain the properties of determinants;		*	
	2.4.2	evaluate the determinant without expansion (using properties of determinants);			*

**NOTES**

			K	U	A
2.5	System of Linear Equations	2.5.1	distinguish between homogeneous and non-homogeneous linear equations in two and three unknowns;		
		2.5.2	solve a system of three homogeneous linear equations in three unknowns;		
		2.5.3	solve a system of 3 by 3 non-homogeneous linear equations using:		
		i.	matrix inversion method		
		ii.	Cramer's rule.		
<b>3.</b>	<b>Sequences and series</b>	<b>Candidates should be able to:</b>			
3.1	Sequence	3.1.1	describe sequence (progression) and its terms;		
		3.1.2	find the general term of a sequence;		
3.2	Arithmetic Sequence	3.2.1	describe an arithmetic sequence;		
		3.2.2	derive the formula of $n^{\text{th}}$ or general term of an arithmetic sequence;		
		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	find ' $n$ ' arithmetic means between two numbers;		
3.4	Arithmetic Series	3.4.1	identify arithmetic series;		
		3.4.2	derive the formula of 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	identify geometric sequence;	*	
		3.5.2	derive the formula of $n^{\text{th}}$ or general term of a geometric sequence ;		*
		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	find 'n' geometric means between two numbers;		*
3.7	Geometric Series	3.7.1	identify a geometric series;	*	
		3.7.2	find the sum to $n$ 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	identify harmonic sequence;	*	
		3.8.2	find the $n^{\text{th}}$ term of harmonic sequence;		*
		3.8.3	solve problems involving harmonic sequence;		*
3.9	Harmonic Mean	3.9.1	calculate a harmonic mean between two numbers;		*
		3.9.2	find $n$ harmonic means between two numbers;		*
		3.9.3	calculate the relationship between arithmetic, geometric and harmonic means;		*

**NOTES**

4. Miscellaneous Series		Candidates should be able to:			
4.1	Evaluation of $\sum n, \sum n^2$ and $\sum n^3$	4.1.1	identify $\sum$ (sigma) notation to denote the sum;	*	
		4.1.2	find the sum of: <ul style="list-style-type: none"> <li>i. the first <math>n</math> natural numbers (<math>\sum n</math>)</li> <li>ii. the squares of the first <math>n</math> natural numbers (<math>\sum n^2</math>)</li> <li>iii. the cubes of the first <math>n</math> natural numbers (<math>\sum n^3</math>);</li> </ul>		*
		4.1.3	solve problems involving ( $\sum n$ ), ( $\sum n^2$ ), ( $\sum n^3$ )		*
5. Permutation, Combination and Probability		Candidates should be able to:			
5.1	Factorial of a Natural Number	5.1.1	explain the concept of the product of the first $n$ natural numbers as $n!$ (Krampe's factorial) and fact $0! = 1$ ;		*
5.2	Counting Techniques (Fundamental Principle of Counting, Permutation and Combination)	5.2.1	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: ${}^n P_r = \frac{n!}{(n-r)!}$ and ${}^n P_n = n!$ ;	*	
		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 ${}^n C_r$ ;	*	

**NOTES**

K	U	A
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	<p>5.2.8 prove that:</p> <p>i.. <math>{}^n C_r = \binom{n}{r} = \frac{n!}{r!(n-r)!}</math></p> <p>ii. <math>\binom{n}{n} = \binom{n}{0} = 1</math></p> <p>iii. <math>\binom{n}{r} = \binom{n}{n-r}, \binom{n}{1} = \binom{n}{n-1} = n</math></p> <p>iv. <math>\binom{n}{r} + \binom{n}{r-1} = \binom{n+1}{r};</math></p> <p>5.2.9 solve problems involving combination;</p>		*	
5.3 Probability	<p>5.3.1 describe the following terms:</p> <p>i. statistical experiment</p> <p>ii. sample space and an event</p> <p>iii. mutually exclusive and mutually inclusive (non-exclusive) events;</p> <p>iv. equally likely events</p> <p>v. dependent and independent events</p> <p>vi. simple and compound events;</p>		*	

**NOTES**

			K	U	A
	5.3.2	apply the formula for probability of occurrence of an event $E$ , that is $P(E) = \frac{n(E)}{n(S)}, 0 \leq P(E) \leq 1;$			*
	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	describe 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	describe the law of multiplication of probability i. $P(A \cap B) = P(A) \times P(B A)$ OR $P(A \cap B) = P(B) \times P(A B)$ 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;			*
<b>6.</b>	<b>Mathematical Induction and Binomial</b>	<b>Candidates should be able to:</b>			
6.1	Mathematical Induction	6.1.1	state the principle of mathematical induction;	*	
		6.1.2	apply the principle of mathematical induction to prove the statements, identities and formulae;		*



**NOTES**

			K	U	A
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	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.			*
<b>7. Quadratic Equations</b>	<b>Candidates should be able to:</b>				
7.1 Revision of the work done in previous classes (Exercise)	7.1.1	describe quadratic equation in standard form;		*	
	7.1.2	solve a quadratic equation in one variable by; i. factorization method ii. completing the square method iii. using quadratic formula;			*

**NOTES**

			K	U	A	
7.2	Solution of Equation Reducible to Quadratic Equation in one Variable (Examples and Exercises)	7.2.1	<p>solve equations reducible to quadratic equation in one variable such as</p> <p>i. <math>ax^{2n} + bx^n + c = 0, a \neq 0</math></p> <p>ii. <math>(x+a)(x+b)(x+c)(x+d) = k</math>, where <math>a + b = c + d</math></p> <p>iii. exponential equations (in which the variables occur in exponents e.g. <math>a^{2x} - b.a^{x+2} + k = 0</math>);</p> <p>iv. reciprocal equations <math>[a(x^2 + \frac{1}{x^2}) + b(x + \frac{1}{x}) + c = 0]</math></p> <p>v. radical equations; (check extraneous roots if any by substitution)</p> <p>a. <math>l(ax^2 + bx) + m\sqrt{ax^2 + bx + c} = 0</math></p> <p>b. <math>\sqrt{x+a} + \sqrt{x+b} = \sqrt{x+c}</math></p> <p>c. <math>\sqrt{ax^2 + bx + c} + \sqrt{px^2 + qx + r} = \sqrt{lx^2 + mx + n}</math> (where <math>ax^2 + bx + c</math>, <math>px^2 + qx + r</math> and <math>lx^2 + mx + n</math> have a common factor);</p> <p>d. <math>\sqrt{ax^2 + bx + c} + \sqrt{px^2 + qx + r} = mx + n</math> { where <math>(mx + n)</math> is a factor of <math>(ax^2 + bx + c) - (px^2 + qx + r)</math> }</p>			*
7.3	Nature of the Roots of a Quadratic Equation	7.3.1	define discriminant ( $b^2 - 4ac$ ) of the quadratic equation $ax^2 + bx + c = 0; a \neq 0$ ;	*		*
		7.3.2	determine the nature of roots of a given quadratic equation and verify the result by solving the equation;			*
7.4	Cube and Fourth Roots of Unity and their Properties	7.4.1	identify complex cube roots of unity i.e. $\omega$ and $\omega^2$ ;	*		*
		7.4.2	find the cube roots of unity and other numbers (e.g. $\pm 8, \pm 27$ etc);			*
		7.4.3	prove the properties of cube roots of unity;		*	*
		7.4.4	apply properties of cube roots of unity to solve problems;			*
		7.4.5	find the fourth roots of unity;			*
		7.4.6	describe the properties of fourth roots of unity ;		*	

**NOTES**

			K	U	A	
7.5	Roots and Coefficient of a Quadratic Equation	7.5.1	find the relationship between the roots and the coefficient of a quadratic equation;			*
		7.5.2	find the sum and product of the roots of a given quadratic equation without solving it;			*
		7.5.3	solve problems based on the sum and product of roots;			*
		7.5.4	find a quadratic equation whose roots are given;			*
		7.5.5	find the value(s) of unknown(s) involved in a given quadratic equation when <ul style="list-style-type: none"> <li>i. sum of roots is equal to the product of roots</li> <li>ii. sum of the squares of roots is equal to a given number;</li> <li>iii. roots differ by a given number</li> <li>iv. roots satisfy a given relation (e.g. the relation <math>2\alpha + 5\beta = 7</math> and <math>\alpha = \beta</math>, where <math>\alpha</math> and <math>\beta</math> are the roots of given equation)</li> <li>v. both sum and product of roots are equal to a given number;</li> </ul>			*
7.6	Formation of Quadratic Equation	7.6.1	establish the formula: $x^2 - (\text{sum of roots})x + (\text{product of roots}) = 0$ to find a quadratic equation from the given roots;		*	
		7.6.2	find a quadratic equation whose roots, for example, are : <ul style="list-style-type: none"> <li>i. <math>2\alpha + 1, 2\beta + 1</math></li> <li>ii. <math>\alpha^2, \beta^2</math></li> <li>iii. <math>\frac{1}{\alpha}, \frac{1}{\beta}</math></li> <li>iv. <math>\frac{\alpha}{\beta}, \frac{\beta}{\alpha}</math></li> <li>v. <math>\alpha + \beta, \frac{1}{\alpha} + \frac{1}{\beta}</math></li> <li>vi. <math>\alpha^3, \beta^3</math> etc.;</li> </ul> where $\alpha$ and $\beta$ are the roots of a given quadratic equation ;			*

**NOTES**

			K	U	A	
7.7	Synthetic Division	7.7.1 7.7.2	apply remainder theorem and factor theorem to solve related problems; apply synthetic division to:			* *
			i. find the quotient and remainder when a given polynomial is divided by linear polynomial ii. find the value(s) of unknown(s) if the factors of a polynomial are given iii. solve a cubic equation if one root of the equation is given iv. solve a bi-quadratic (quartic) equation if two of the real roots of the equation are given;			
7.8	Simultaneous Equations	7.8.1	solve system of two equation in two variables when: i. one equation is linear and the other is quadratic ii. both the equations are quadratic;			*
7.9	Applications of Quadratic Equations	7.9.1	solve word problems related to quadratic equations.			*



**NOTES**

<b>8. Introduction to Trigonometry and Trigonometric Identities</b>	<b>Candidates should be able to:</b>				
8.1 Measurement of an Angle	8.1.1	explain Sexagesimal system (degree, minute and second);	*	*	
	8.1.2	define degree;	*		
	8.1.3	convert an angle given in D°M'S" form into a decimal form and vice versa;			*
8.2 Circular Measure	8.2.1	define radian (measure of an angle in circular system);	*		
	8.2.2	convert an angle from degree to radian and vice versa;			*
	8.2.3	prove arc length $l = r\theta$ , where $r$ is the radius of the circle, $l$ is the length of circular arc and $\theta$ is the central angle measured in radians;		*	
	8.2.4	apply $l = r\theta$ to solve related problems;			*
	8.2.5	prove area of sector of a circle $A = \frac{1}{2}r^2\theta$ ;		*	
	8.2.6	apply $A = \frac{1}{2}r^2\theta$ to solve related problems;			*
8.3 Trigonometric Ratios	8.3.1	identify quadrants and quadrantal angles;	*		
	8.3.2	identify signs of trigonometric ratios in different quadrants;	*		
	8.3.3	find the values of remaining trigonometric ratios if one of the trigonometric ratio is given;			*
8.4 Trigonometric Identities	8.4.1	prove the following fundamental trigonometric identities i. $\sin^2 \theta + \cos^2 \theta = 1$ ii. $1 + \tan^2 \theta = \sec^2 \theta$ iii. $1 + \cot^2 \theta = \operatorname{cosec}^2 \theta$ ;		*	
	8.4.2	apply the above identities to prove different trigonometric relations;			*

**NOTES**

			K	U	A
8.5	Angle of Elevation and Depression	8.5.1 8.5.2	illustrate the concept of angle of elevation and depression; solve problems involving angle of elevation and depression in a right angled triangle.	*	*
8.6	Fundamental Law of Trigonometry	8.6.1 8.6.2 8.6.3	apply distance formula to find the distance between two points; establish the fundamental law of trigonometry by using distance formula: $\cos(\alpha - \beta) = \cos \alpha \cos \beta + \sin \alpha \sin \beta$ 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. $\tan(\alpha \pm \beta) = \frac{\tan \alpha \pm \tan \beta}{1 \mp \tan \alpha \tan \beta}$ apply the above formulae to solve related problems;	*	*
8.7	Trigonometric Ratios of Allied Angles	8.7.1 8.7.2 8.7.3	identify allied angles; apply fundamental law and its deductions to derive trigonometric ratios of allied angles; convert $a \sin \theta \pm b \cos \theta$ in the form $r \sin(\theta \pm \phi)$ where $a = r \cos \phi$ and $b = r \sin \phi$ ;	*	*
8.8	Double, Half and Triple Angle Identities	8.8.1 8.8.2	derive double angle, half angle and triple angle identities from fundamental law and its deductions; apply the above identities to prove different trigonometric relations;		*
8.9	Sum, Difference and Product of Sines and Cosines	8.9.1 8.9.2	derive the product (of sines and cosines) as sums or differences (of sines and cosines) and vice versa; apply the sums or differences (of sines and cosines) as products (of sines and cosines) and vice versa;		*

**NOTES**

<b>9. Application of Trigonometry</b>	<b>Candidates should be able to:</b>				
9.1 Solution of Triangles	9.1.1	solve a right-angled triangle when measures of: i. two sides are given ii. one side and one angle are given;			*
	9.1.2	describe oblique triangle;		*	
	9.1.3	prove that: i. the law of cosines ii. the law of sines iii. the law of tangents and deduce respective half angle formulae;		*	
	9.1.4	apply the above laws to solve problems related to oblique triangles;			*
9.2 Area of a Triangle	9.2.1	derive the formulae for 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 (Heron's formula);			*
	9.2.2	use the above formulae to find the area of a triangle;			*
9.3 Circles Connected with triangle	9.3.1	illustrate circum-circle, in-circle and escribed-circle;		*	
	9.3.2	derive the formula for: i. circum-radius ii. in-radius iii. escribed-radii			*
	9.3.3	use the above formula to find the circum-radius, in-radius and escribed radii;			*
	9.3.4	apply the above formulae to deduce different identities;			*

**NOTES**

10. Graphs of Trigonometric, Inverse Trigonometric Functions and Solution of Trigonometric Equations		Candidates should be able to:			
10.1 Period of Trigonometric Functions	10.1.1	find the domain and range of the trigonometric functions;			*
	10.1.2	distinguish between even and odd trigonometric functions;		*	
	10.1.3	discuss the graphical behaviour of even and odd trigonometric functions;		*	
	10.1.4	describe the period of trigonometric functions;		*	
	10.1.5	discuss the periodicity of trigonometric functions and effects of periodicity on their graphs;		*	
	10.1.6	find the period of trigonometric functions by definition;			*
	10.1.7	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;			*
10.2 Graphs of Trigonometric Functions	10.2.1	identify the shapes of the graphs of sine, cosine and tangent function;	*		
	10.2.2	draw the graphs of the six basic trigonometric functions within the domain from $-2\pi$ to $2\pi$ ;			*
	10.2.3	draw the graphs of trigonometric functions e.g. $\sin 2\theta$ , $\cos 2\theta$ , $\sin \frac{\theta}{2}$ , $\cos \frac{\theta}{2}$ etc;			*



**NOTES**

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		10.2.4	illustrate the concept of periodic, even or odd and translation properties of the graphs of $\sin \theta$ , $\cos \theta$ , and $\tan \theta$ , for example $\sin \theta$ , has: i. periodic property $\sin(\theta \pm 2\pi) = \sin \theta$ ii. odd property $\sin(-\theta) = -\sin \theta$ iii. translation property $\sin(\theta - \pi) = -\sin \theta$ and $\sin(\pi - \theta) = \sin \theta$ ;	*	
10.3	Solution of Trigonometric Equations Graphically	10.3.1	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,		*
		10.3.2	find the solutions of trigonometric equations graphically;		*
10.4	Inverse Trigonometric Functions	10.4.1	describe the inverse trigonometric functions and their domain and range;	*	
		10.4.2	find domains and ranges of inverse trigonometric functions;		*
		10.4.3	draw the graphs of inverse trigonometric functions;		*
		10.4.4	prove the addition and subtraction formulae of inverse trigonometric functions;	*	
		10.4.5	apply addition and subtraction formulae of inverse trigonometric functions to verify related identities;		*
10.5	Solution of General Trigonometric Equations	10.5.1	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 into account the period of a trigonometric function.		*

**NOTES**

Part II (Class XII)

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11. Introduction to Symbolic Package Maple	Candidates should be able to:				
11.1 Introduction	11.1.1	explain MAPLE integrated development environment;			
	11.1.2	identify basic MAPLE commands;			
	11.1.3	apply MAPLE as a calculator;			CA
	11.1.4	use online MAPLE help;			
11.2 Polynomials	11.2.1	apply MAPLE commands to: i. find the factors of a polynomial ii. expand an expression iii. simplify an expression iv. simplify a rational expression v. find the value of an expression by substituting value;			CA
11.3 Graphics	11.3.1	apply MAPLE Commands to: i. plot a two-dimensional graph; ii. demonstrate domain and range of a plot; iii. sketch parametric equations; iv. use plotting options;			CA
11.4 Matrices	11.4.1	identify matrix and vector entry arrangement through MAPLE;			
	11.4.2	apply matrix operations;			CA
	11.4.3	Find the inverse and transpose of a matrix;			

**NOTE:**

MAPLE is given zero weightage as per recommendation of ministry of education, curriculum wing.  
MAPLE exercises can be used as **Classroom Activities (CA)**.

**NOTES**

12. Functions and Limits		Candidates should be able to:		
12.1 Functions	12.1.1	describe the concept of a function, its domain, co-domain and range;		*
	12.1.2	find the value of a function for given values of variables, dependent and independent variables;		*
	12.1.3	describe <ul style="list-style-type: none"> <li>i. Into function</li> <li>ii. Onto (Surjective) function</li> <li>iii. One to One and Into (Injective) function</li> <li>iv. One to One and Onto (Bijective) function;</li> </ul>		*
	12.1.4	distinguish between even and odd functions;		*
12.2 Inverse Functions	12.2.1	describe inverse of a function;		*
	12.2.2	find the inverse of a function and its domain and range;		*
12.3 Graph of Functions	12.3.1	distinguish between linear, quadratic and square root functions;		*
	12.3.2	draw the graph of modulus function (e.g. $y =  x $ , $y = c \times  x \pm a  \pm b$ )		*
	12.3.3	find the domain and range of functions through graph;		*
12.4 Composition of Functions	12.4.1	describe the composition of functions and symbol used for composition of functions;		*
	12.4.2	find the composition of two given functions;		*
	12.4.3	find the corresponding values of composite functions for given values of a variable;		*
12.5 Inverse of Composition of Functions	12.5.1	describe the inverse of composition of two given functions with examples;		*
	12.5.2	solve problems related to composite function and inverse composite function;		*
12.6 Types of Functions	12.6.1	distinguish between algebraic, trigonometric, inverse trigonometric, exponential, logarithmic, hyperbolic (and their identities), explicit and implicit functions, even and odd function, and parametric representation of functions;		*

**NOTES**

			K	U	A
12.7 Graphical Representations	12.7.1	sketch and interpret the graph of: <ol style="list-style-type: none"> <li>the explicitly defined functions like <math>y = f(x)</math> where <math>f(x) = e^x</math>, <math>f(x) = a^x</math>, <math>f(x) = \log_a x</math>, <math>f(x) = \log_e x</math> or <math>\ln x</math>;</li> <li>the implicitly defined relations such as <math>x^2 + y^2 = a^2</math> and <math>\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1</math> (vertical line test to distinguish between graph of a function and of a non function)</li> <li>the parametric equations of functions such as <math>x = at^2</math>, <math>y = 2at</math> <math>x = a \sec \theta</math>, <math>y = b \tan \theta</math>;</li> <li>the piecewise functions, for example <math>y = \begin{cases} x &amp; \text{when } 0 \leq x &lt; 1 \\ x-1 &amp; \text{when } 1 \leq x \leq 2 \end{cases}</math>;</li> </ol>		*	
	12.7.2	apply MAPLE graphic commands for two-dimensional plot of: <ol style="list-style-type: none"> <li>an expression (or a function)</li> <li>parameterized form of a function</li> <li>implicit function, by restricting domain and range;</li> </ol>			CA
	12.7.3	apply MAPLE package plots for plotting different types of functions;			
12.8 Limit of a Function	12.8.1	identify a real number on the number line;	*		
	12.8.2	describe and represent: <ol style="list-style-type: none"> <li>open interval</li> <li>closed interval</li> <li>half open and half closed intervals on the number line;</li> </ol>		*	



**NOTES**

			K	U	A
	12.8.3	describe the meaning of a phrase: i. $x$ tends to zero ( $x \rightarrow 0$ ) ii. $x$ tends to $a$ ( $x \rightarrow a$ ) iii. $x$ tends to infinity ( $x \rightarrow \infty$ );		*	
	12.8.4	describe the limit of a sequence;		*	
	12.8.5	find the limit of a sequence whose $n^{\text{th}}$ term is given;			*
	12.8.6	define the limit of a function;	*		
	12.8.7	state the theorems of limits for sum, difference, power, product and quotient of functions;	*		
	12.8.8	apply the above theorems to find the limit;			*
12.9 Important Limits	12.9.1	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 ( $x \rightarrow a$ ) ii. $\left(1 + \frac{1}{x}\right)^x$ when ( $x \rightarrow \infty$ ) 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 ( $x \rightarrow 0$ );			*
	12.9.2	evaluate limits of different algebraic, exponential, logarithmic and trigonometric functions;			*
	12.9.3	apply a MAPLE command <i>limit</i> to evaluate the limit of a function;			CA

**NOTES**

			K	U	A
12.10 Continuous and Discontinuous Functions	12.10.1	illustrate left hand and right hand limits with examples to decide the existence and non-existence of limit of a function;		*	
	12.10.2	describe the continuity of a function at a point and in an interval;		*	
	12.10.3	find the continuity and discontinuity of a function at a point and in an interval;			*
	12.10.4	apply Maple command <i>iscont</i> to test continuity of a function at a point and in a given interval.			CA
<b>13. Differentiation</b>		<b>Candidates should be able to:</b>			
13.1 Derivative of a Function	13.1.1	distinguish between independent and dependent variables;		*	
	13.1.2	estimate corresponding change in the dependent variable when independent variable is increased or decreased;			*
	13.1.3	explain the concept of a rate of change;		*	
	13.1.4	distinguish between the average rate of change and the instantaneous rate of change;		*	
	13.1.5	describe the 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;		*	
	13.1.6	find the derivative of or differentiate $y = x^n$ , where $n \in Z$ (the set of integers) and $y = (ax + b)^n$ , where $n = \frac{p}{q}$ and $p, q$ are integers such that $q \neq 0$ , by definition or by ab-initio or from first principles;			*
	13.1.7	find the derivative of or differentiate algebraic functions by using direct method (power rule);			*

**NOTES**

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13.2	Theorems on Differentiation and their Applications	13.2.1	apply the following theorems for differentiation; i. the derivative of a constant is zero; ii. the derivative of any constant multiple of a function is equal to the product of that constant and the derivative of the function; iii. the derivative of a sum (or difference) of two functions is equal to the sum (or difference) of their derivatives; iv. the derivative of a product of two functions is equal to (the first function) $\times$ (derivative of the second function) plus (derivative of the first function) $\times$ (the second function); v. 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;			*
13.3	Chain Rule	13.3.1	prove $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$ when $y = f(u)$ and $u = g(x)$ ; and $\frac{dy}{dx} = \frac{1}{\frac{dx}{dy}}$		*	
		13.3.2	apply the above rules to solve related problems;			*

**NOTES**

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	13.3.3	apply the chain rule to show that $\frac{d}{dx}[f(x)]^n = n[f(x)]^{n-1} \frac{d}{dx} f(x)$ ;			*
	13.3.4	find the derivative of implicit function;			*
13.4	Differentiation of Trigonometric and Inverse Trigonometric Functions	13.4.1 find the derivative of or differentiate trigonometric functions by first principles;			*
		13.4.2 find the derivative of trigonometric functions by using direct method;			*
		13.4.3 find the derivative of or differentiate inverse trigonometric functions by using formulae;			*
13.5	Differentiation of Exponential and Logarithmic Functions	13.5.1 find the derivative of $e^x$ and $a^x$ from first principles ;			*
		13.5.2 find the derivative of $\ln x$ and $\log_a x$ from first principles;			*
		13.5.3 find the derivative of exponential and logarithmic functions by using direct method;			*
		13.5.4 apply logarithmic differentiation to find the derivative of algebraic expressions involving product, quotient and power;			*
13.6	Differentiation of Hyperbolic and Inverse Hyperbolic Functions	13.6.1 find the derivative of or differentiate: i. hyperbolic functions ( $\sinh x, \cosh x, \tanh x, \operatorname{cosech} x, \operatorname{sech} x$ and $\operatorname{coth} x$ ); ii. inverse hyperbolic functions ( $\sinh^{-1} x, \cosh^{-1} x, \tanh^{-1} x, \operatorname{cosech}^{-1} x, \operatorname{sech}^{-1} x$ , and $\operatorname{coth}^{-1} x$ );			*
		13.6.2 apply MAPLE command <i>diff</i> to differentiate a function.			CA



**NOTES**

14. Higher Order Derivatives and its Applications	Candidates should be able to:				
14.1 Higher Order Derivatives	14.1.1	find the higher order derivatives of algebraic, trigonometric, exponential and logarithmic functions;			*
	14.1.2	find the second derivative of implicit, inverse trigonometric and parametric functions;			*
	14.1.3	apply MAPLE command <i>diff</i> repeatedly to find higher order derivative of a function;			CA
14.2 Maclaurin's and Taylor's Expansion	14.2.1	state Maclaurin's and Taylor's theorems;	*		*
	14.2.2	apply these theorems to expand $\sin x$ , $\cos x$ , $\tan x$ , $a^x$ , $e^x$ , $\log_a(1+x)$ and $\ln(1+x)$ ;			*
	14.2.3	apply MAPLE command <i>taylor</i> to find Taylor's expansion for a given function;			CA
14.3 Application of Derivatives	14.3.1	find the angle of intersection of the two curves;			*
	14.3.2	find the equation of tangent and normal to the curve at a given point;			*
	14.3.3	interpret geometrical interpretation of derivative;		*	*
	14.3.4	find the point on a curve where the tangent is parallel to the given line;			*
14.4 Maxima and Minima	14.4.1	define increasing and decreasing functions;	*		
	14.4.2	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 $(a,b)$ );		*	
	14.4.3	investigate a given function for extreme values;			*

**NOTES**

			K	U	A
	14.4.4	state the second derivative rule to find the extreme values of a function at a point;	*		
	14.4.5	apply second derivative rule to examine a given function for extreme values;			*
	14.4.6	solve real life problems related to extreme values;			*
	14.4.7	apply MAPLE command <i>maximize</i> and <i>minimize</i> to compute maximum and minimum value of a function.			CA
<b>15. Partial Fractions</b>		<b>Candidates should be able to:</b>			
15.1	Revision	15.1.1	distinguish proper and improper rational fractions;		*
15.2	Resolution of Fractions into Partial Fractions	15.2.1	explain the meaning of partial fraction;		*
		15.2.2	convert $\frac{P(x)}{Q(x)}$ 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.		*
<b>16. Integration</b>		<b>Candidates should be able to:</b>			
16.1	Introduction	16.1.1	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;		*
		16.1.2	find the indefinite integrals to relate simple standard integrals formula from standard differentiation formulae;		*

**NOTES**

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16.2 Rules of Integration	16.2.1	describe the following rules of integration: i. $\int \frac{d}{dx}[f(x)]dx = \frac{d}{dx}[\int f(x)dx] = f(x) + c$ where $c$ is the 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;		*	
	16.2.2	prove the results for the following integrals by using the standard differentiation formulae : i. $\int [f(x)]^n f'(x)dx,$ ii. $\int \frac{f'(x)}{f(x)} dx,$ iii. $\int e^{ax} [af(x) + f'(x)]dx.$		*	
	16.2.3	apply the above rules and standard differentiation formulae to find the indefinite integrals;			*
16.3 Integration by Substitution	16.3.1	explain the method of integration by substitution;		*	
	16.3.2	apply method of integration by substitution to evaluate the indefinite integrals;			*

**NOTES**

			K	U	A
	16.3.3	<p>apply the method of substitution to evaluate the integrals of the following types:</p> <p>i. <math>\int \frac{dx}{a^2 - x^2}</math>, <math>\int \sqrt{a^2 - x^2} dx</math>, <math>\int \frac{dx}{\sqrt{a^2 - x^2}}</math>,</p> <p>ii. <math>\int \frac{dx}{a^2 + x^2}</math>, <math>\int \sqrt{a^2 + x^2} dx</math>, <math>\int \frac{dx}{\sqrt{x^2 + a^2}}</math>,</p> <p>iii. <math>\int \frac{dx}{x^2 - a^2}</math>, <math>\int \sqrt{x^2 - a^2} dx</math>, <math>\int \frac{dx}{\sqrt{x^2 - a^2}}</math>,</p> <p>iv. <math>\int \frac{dx}{ax^2 + bx + c}</math>, <math>\int \frac{dx}{\sqrt{ax^2 + bx + c}}</math>,</p> <p>v. <math>\int \frac{px + q}{ax^2 + bx + c} dx</math>, <math>\int \frac{px + q}{\sqrt{ax^2 + bx + c}} dx</math>.</p>			*
16.4	Integration by Parts	<p>16.4.1 write the formula for integration by parts;</p> <p>16.4.2 apply the method of integration by parts to evaluate the integrals of the following types:  <math>\int \sqrt{a^2 - x^2} dx</math>, <math>\int \sqrt{a^2 + x^2} dx</math>, <math>\int \sqrt{x^2 - a^2} dx</math> ;</p> <p>16.4.3 evaluate integrals using integration by parts;</p>	*		*
16.5	Integration using Partial Fractions	<p>16.5.1 apply partial fractions to find <math>\int \frac{f(x)}{g(x)} dx</math>, where <math>f(x)</math> and <math>g(x)</math> are algebraic functions such <math>g(x) \neq 0</math> .;</p>			*



**NOTES**

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16.6 Definite Integrals	16.6.1	define definite integral as the limit of a sum;	*		
	16.6.2	describe the fundamental theorem of integral calculus and recognize the following basic properties:		*	
		i. $\int_a^a f(x)dx = 0,$			
		ii. $\int_a^b f(x)dx = -\int_b^a f(x)dx,$			
		iii. $\int_a^b f(x)dx = \int_a^c f(x)dx + \int_c^b f(x)dx, a < c < b,$			
		iv. $\int_{-a}^a f(x)dx = \begin{cases} 2\int_0^a f(x)dx & \text{when } f(-x) = f(x) \text{ (even function) ;} \\ 0 & \text{when } f(-x) = -f(x) \text{ (odd function)} \end{cases}$			
	16.6.3	apply the techniques of integration using properties to evaluate the definite integrals;			*
	16.6.4	describe the definite integral as the area under the curve;		*	
	16.6.5	apply definite integrals to calculate the area under the curve;			*

**NOTES**

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16.7	Differential Equation	16.7.1	explain the concept of ordinary differential equation (DE), order of DE and degree of DE;		*	
		16.7.2	solve differential equations of first order and first degree by separating the variables;			*
		16.7.3	solve word problems (e.g. finding displacement from velocity , etc );			*
		16.7.4	use MAPLE command mt to evaluate definite and indefinite integrals.			CA
<b>17. Plane Analytic Geometry (Straight Line)</b>		<b>Candidates should be able to:</b>				
17.1	Division of a Line Segment	17.1.1	derive distance formula between two points given in Cartesian plane;			*
		17.1.2	apply distance formula to calculate the distance between two points given in Cartesian plane;			*
		17.1.3	calculate the coordinates of a point that divides the line segment in a given ratio (internally and externally) and apply the results in related problems;			*
		17.1.4	prove that the medians and angle bisectors of a triangle are concurrent;		*	
17.2	Slope of a Straight Line	17.2.1	define the slope of a line;	*		
		17.2.2	prove the formula for the slope of a line passing through two points;		*	
		17.2.3	find the slope of a line passing through two points;			*
		17.2.4	describe the conditions when two straight lines with given slopes are: i. parallel to each other ii. perpendicular to each other;		*	
		17.2.5	apply the above conditions to solve the problems;			*
17.3	Equation of a Straight Line Parallel to Co-ordinate Axes	17.3.1	find the equation of a straight line parallel to: i. $y$ -axis and at a distance of $a$ unit from it ii. $x$ -axis and at a distance of $b$ unit from it;			*

**NOTES**

			K	U	A	
17.4	Standard Form of Equation of a Straight Line	17.4.1	describe intercepts of a straight line;		*	
		17.4.2	derive equation of a straight line in: i. slope-intercept form ii. point-slope form iii. two-points form iv. intercepts form v. normal form;			*
		17.4.3	explain the concept that a linear equation in two variables represents a straight line;		*	
		17.4.4	convert the general form of the equation of a straight line into the other forms;			*
		17.4.5	find the equation of straight line by using different given conditions;			*
17.5	Distance of a Point From a Line	17.5.1	determine the position of a point with respect to a line (i.e. above or below the line);			*
		17.5.2	calculate the perpendicular distance from a point to the given straight line;			*
		17.5.3	find the distance between two parallel lines;			*
17.6	Angle Between Lines	17.6.1	find the angle between two coplanar intersecting straight lines;			*
		17.6.2	find the equation of family of lines passing through the point of intersection of two given lines;			*
		17.6.3	calculate angles of the triangle when the slopes of the sides are given;			*
17.7	Concurrency of Straight Lines	17.7.1	find the condition of concurrency of three straight lines;			*
		17.7.2	find the equation of median, altitude and right bisector of a triangle;			*
		17.7.3	prove that three: i. right bisectors ii. medians iii. Altitudes of a triangle are concurrent;		*	

**NOTES**

			K	U	A	
17.8	Area of a Triangular Region	17.8.1	find the area of a triangular region and hence quadrilateral region whose vertices are given;			*
17.9	Homogenous Equation	17.9.1	identify homogeneous linear and quadratic equations in two variables;	*		
		17.9.2	find the equation of the pair of lines represented jointly by the 2 <sup>nd</sup> degree homogeneous equation $ax^2 + 2hxy + by^2 = 0$ ;			*
		17.9.3	discuss the nature of the lines of $ax^2 + 2hxy + by^2 = 0$ by using the discriminant $D = 2\sqrt{h^2 - ab}$ ;		*	
		17.9.4	find the acute angle between a pair of straight lines passing through the origin.			*
<b>18. Linear Programming</b>		<b>Candidates should be able to:</b>				
18.1	Introduction	18.1.1	describe the terms used in the linear programming;		*	
		18.1.2	describe linear programming (LP) as a planning of allocation of limited resources to obtain an optimal result;		*	
18.2	Linear Inequalities	18.2.1	explain the concept of algebraic solutions of linear inequalities in one variable and represent them on number line;		*	
		18.2.2	interpret graphically the linear inequalities in two variables;		*	
		18.2.3	determine graphically the region bounded by, at most, 3 simultaneous linear inequalities of non-negative variables and shade the region bounded by them;			*
18.3	Feasible Region	18.3.1	describe: i. linear programming problem ii. objective function iii. problem constraints iv. decision variables;		*	
		18.3.2	illustrate graphically the feasible region (or solution space) of a LP problem;		*	
		18.3.3	find the feasible region of LP problems;			*



**NOTES**

			K	U	A
18.4 Optimal Solution	18.4.1	describe the optimal solution of a LP problem;		*	
	18.4.2	find the optimal solution (graphical) through the following systematic procedure: i. to establish the mathematical formulation of LP problems ii. construct the graph iii. identify the feasible region iv. locate the solution points v. evaluate the objective function vi. select the optimal solution vii. verify the optimal solution by actually substituting values of variables from the feasible region;			*
	18.4.3	solve simple LP problems.			*
<b>19. Circles</b>		<b>Candidates should be able to:</b>			
19.1 Introduction	19.1.1	describe conics and demonstrate members of its family i.e. circle, parabola, ellipse and hyperbola;		*	
19.2 Equation of Circle	19.2.1	describe the concept of circle and related terms;		*	
	19.2.2	derive the equation of a circle in standard form i.e. $(x - h)^2 + (y - k)^2 = r^2$ ;			*
	19.2.3	describe the general equation of a circle $x^2 + y^2 + 2gx + 2fy + c = 0$ ;		*	
	19.2.4	find the relationship between the general form and the standard form of the circle to find its centre and radius;			*
	19.2.5	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;			*
	19.2.6	apply the above concepts of circles to solve related problems;			*

**NOTES**

			K	U	A
19.3	Tangents and Normals	19.3.1 find the condition when a line intersects a circle; 19.3.2 find the condition when a line touches a circle; 19.3.3 find the equation of a tangent to a circle in slope form; 19.3.4 find the equations of a tangent and a normal to a circle i. at a point ii. which is parallel to a line iii. which is perpendicular to a line; 19.3.5 calculate the length of tangent to a circle from a given external point; 19.3.6 determine whether the point lies inside, on or outside the circle; 19.3.7 prove that the two tangents drawn to a circle from an external point are equal in length.			* * * *  * *
<b>20. Parabola</b>		<b>Candidates should be able to:</b>			
20.1	Introduction	20.1.1 describe parabola and its elements (i.e. focus, directrix, eccentricity, vertex, axis, focal chord and latus rectum);		*	
20.2	Equation of a Parabola	20.2.1 derive the general form of an equation of a parabola; 20.2.2 derive the standard equations of parabola; 20.2.3 find the elements by sketching the parabola; 20.2.4 find the equation of a parabola with the given elements, for example: i. focus and vertex ii. focus and directrix iii. vertex and directrix etc;			* * * *
20.3	Tangents and Normals	20.3.1 find the condition when a line is tangent to a parabola at a point; 20.3.2 find the equation of a tangent and a normal to a parabola: i. at a point ii. which is parallel to a line iii. which is perpendicular to a line;			* *
20.4	Role of Parabola	20.4.1 explain the role of a parabola in daily life (i.e. suspension bridges, projectile etc); 20.4.2 solve word problems related to the above example.		*	*

**NOTES**

			K	U	A
<b>21. Ellipse</b>	<b>Candidates should be able to:</b>				
21.1 Introduction	21.1.1	describe ellipse and its elements (i.e. centre, foci, vertices, co-vertices, directrices, major and minor axes, eccentricity, focal chord and latera recta);		*	
	21.1.2	explain the concept that circle is a special case of an ellipse;		*	
21.2 Equation of an Ellipse	21.2.1	derive the standard form of equation of an ellipse and identify its elements;			*
	21.2.2	find the equation of an ellipse with the given elements, for example: i. major and minor axes ii. two points iii. foci, vertices or lengths of a latera recta etc;			*
	21.2.3	convert a given equation to the standard form of the equation of an ellipse to find its elements;			*
	21.2.4	find the elements by sketching the ellipse;			*
	21.2.5	solve word problems related to ellipse;			*
21.3 Tangents and Normals	21.3.1	find the points of intersection of an ellipse with a line and the condition of tangency;			*
	21.3.2	find the equation of a tangent and a normal to an ellipse: i. at a point ii. which is parallel to a line iii. which is perpendicular to a line.			*
<b>22. Hyperbola</b>	<b>Candidates should be able to:</b>				
22.1 Introduction	22.1.1	describe hyperbola and its elements (i.e. centre, foci, vertices, directrices, transverse and conjugate axes, eccentricity, focal chord and latera recta);		*	

**NOTES**

			K	U	A
22.2 Equation of Hyperbola	22.2.1	derive the standard form of equation of a hyperbola and identify its elements;			*
	22.2.2	find the equation of a hyperbola with the given elements, for example: i. transverse and conjugate axes with centre at origin ii. eccentricity, latera recta and transverse axes iii. focus, eccentricity and centre iv. focus, centre and directrix etc;			*
	22.2.3	convert a given equation to the standard form of equation of a hyperbola to find its elements			*
	22.2.4	find the elements by sketching the hyperbola;			*
	22.2.5	solve word problems related to hyperbola;			
22.3 Tangents and Normals	22.3.1	find the points of intersection of a hyperbola with a line, including the condition of tangency;			*
	22.3.2	find the equation of a tangent and a normal to a hyperbola: i. at a point ii. which is parallel to a line iii. which is perpendicular to a line.			*
<b>23. Translation and Rotation</b>		<b>Candidates should be able to:</b>			
23.1 Translation and Rotation of Axes	23.1.1	describe translation and rotation of axes with examples;		*	
	23.1.2	find the equations of transformation for: i. translation of axes ii. rotation of axes;			*
	23.1.3	find the transformed equation by using translation or rotation of axes;			*
	23.1.4	find the new origin and new axes referred to old origin and old axes;			*
	23.1.5	find the angle through which the axes is 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 Numbers	3	2	3	9	14
2.	Matrices and Determinants	5	2	5	12	19
3.	Sequences and Series	9	4	2	20	26
4.	Miscellaneous Series	1	1	0	2	3
5.	Permutation, Combination and Probability	3	1	10	8	19
6.	Mathematical Induction and Binomial	3	1	1	8	10
7.	Quadratic Equations	9	2	4	16	22
8.	Introduction to Trigonometry and Trigonometric Identities	9	5	6	15	26
9.	Application of Trigonometry	3	0	3	7	10
10.	Graphs of Trigonometric, Inverse Trigonometric Functions and Solution of Trigonometric Equations	5	1	7	11	19
	<b>Total</b>	<b>50</b>	<b>19</b>	<b>41</b>	<b>108</b>	<b>168</b>
	<b>Percentage</b>		<b>11</b>	<b>25</b>	<b>64</b>	<b>100</b>

**Table 2: Allocation of Marks for the Multiple Choice Questions (MCQs), and Constructed Response Questions (CRQs)**

Topic No.	Topics	No. of Sub - Topics	Marks		
			Multiple Choice Questions	Constructed Response Questions	Total
1.	Complex Number	3	3	6	9
2.	Matrices and Determinants	5	5	8	13
3.	Sequences and Series	9	5	9	14
4.	Miscellaneous Series	1			
5.	Permutation, Combination and Probability	3	4	6	10
6.	Mathematical Induction and Binomial Theorem	3	2	6	8
7.	Quadratic Equations	9	5	8	13
8.	Introduction to Trigonometry and their Identities	9	5	7	12
9.	Application of Trigonometry	3	3	8	11
10.	Graph of Trigonometric and Inverse Trigonometric Functions and Solution of Trigonometric Equations	5	3	7	10
	<b>TOTAL</b>	<b>50</b>	<b>35</b>	<b>65</b>	<b>100</b>

**Table 3: Paper Specifications**

<b>Topic No.</b>	<b>Topics</b>	<b>Marks Distribution</b>		<b>Total Marks</b>
1.	Complex Number	MCQs 3 @ 1 Mark CRQ 1 @ 6 Marks		9
2.	Matrices and Determinants	MCQs 5 @ 1 Mark CRQ 1 @ 8 Marks		13
3.	Sequences and Series	MCQs 5 @ 1 Mark CRQs 1 @ 6 Marks *CRQs 2 @ 3 Marks Choose any ONE from TWO		14
4.	Miscellaneous Series			
5.	Permutation Combination and Probability	MCQs 4 @ 1 Mark *CRQs 2 @ 6 Marks Choose any ONE from TWO		10
6.	Mathematical Induction and Binomial Theorem	MCQs 2 @ 1 Mark CRQ 1 @ 6 Marks		8
7.	Quadratic Equations	MCQs 5 @ 1 Mark *CRQs 2 @ 8 Marks Choose any ONE from TWO		13
8.	Introduction to Trigonometry and their Identities	MCQs 5 @ 1 Mark *CRQs 2 @ 7 Marks Choose any ONE from TWO		12
9.	Application of Trigonometry	MCQs 3 @ 1 Mark *CRQs 2 @ 8 Marks Choose any ONE from TWO		11
10.	Graph of Trigonometric and Inverse Trigonometric Functions and Solution of Trigonometric Equations	MCQs 3 @ 1 Mark *CRQs 2 @ 7 Marks Choose any ONE from TWO		10
	<b>Total</b>	<b>MCQs 35</b>	<b>CRQs 65</b>	<b>100</b>

\* 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	
11.	Introduction to Symbolic Package (MAPLE)	4	0	0	0	0
12.	Functions and Limits	10	3	14	12	29
13.	Differentiation	6	0	5	15	20
14.	Higher Order Derivatives and its Application	4	3	2	9	14
15.	Partial Fractions	2	0	2	1	3
16.	Integration	7	2	7	11	20
17.	Plane Analytical Geometry ( Straight Line)	9	2	7	20	29
18.	Linear Programming	4	0	7	4	11
19.	Circles	3	0	4	10	14
20.	Parabola	4	0	2	7	9
21.	Ellipse	3	0	2	7	9
22.	Hyperbola	3	0	1	6	7
23.	Translation and Rotation	1	0	1	4	5
	<b>Total</b>	<b>60</b>	<b>10</b>	<b>54</b>	<b>106</b>	<b>170</b>
	<b>Percentage</b>		<b>6</b>	<b>32</b>	<b>62</b>	<b>100</b>

**Table 5: Allocation of Marks for the Multiple Choice Questions (MCQs), and Constructed Response Questions (CRQs)**

Topic No.	Topics	No. of Sub-Topics	Marks		
			Multiple Choice Questions	Constructed Response Questions	Total
11.	Introduction to Symbolic Package (MAPLE)	4	-	-	-
12.	Functions and Limits	10	4	5	9
13.	Differentiation	6	6	12	18
14.	Higher Order Derivative and Application	4			
15.	Partial Fractions	2			
16.	Integration	7	6	12	18
17.	Plane Analytical Geometry (Straight Line)	9	5	10	15
18.	Linear Programming	4	2	6	8
19.	Circles	3	3	6	9
20.	Parabola	4	7	10	17
21.	Ellipse	3			
22.	Hyperbola	3			
23.	Translation and Rotation	1	2	4	6
	<b>Total</b>	<b>60</b>	<b>35</b>	<b>65</b>	<b>100</b>

**Table 6: Paper Specifications**

<b>Topic No.</b>	<b>Topics</b>	<b>Marks Distribution</b>		<b>Total Marks</b>
11.	Introduction to Symbolic Package (MAPLE)	-		-
12.	Functions and Limits	MCQs 4 @ 1 Mark CRQ 1 @ 5 Marks		9
13.	Differentiation	MCQs 6 @ 1 Mark **CRQs 3 @ 6 Marks Choose any TWO from THREE		18
14.	Higher Order Derivative and Application			
15.	Partial Fractions	MCQs 6 @ 1 Mark **CRQs 3 @ 6 Marks Choose any TWO from THREE		18
16.	Integration			
17.	Plane Analytical Geometry ( Straight Line)	MCQs 5 @ 1 Mark **CRQs 3 @ 5 Marks Choose any TWO from THREE		15
18.	Linear Programming	MCQs 2 @ 1 Mark CRQ 1 @ 6 Marks		8
19.	Circles	MCQs 3 @ 1 Mark *CRQs 2 @ 6 Marks Choose any ONE from TWO		9
20.	Parabola	MCQs 7 @ 1 Mark **CRQs 3 @ 5 Marks Choose any TWO from THREE		17
21.	Ellipse			
22.	Hyperbola			
23.	Translation and Rotation	MCQs 2 @ 1 Mark *CRQs 2 @ 4 Marks Choose any ONE from TWO		6
	<b>Total</b>	<b>MCQs 35</b>	<b>CRQs 65</b>	<b>100</b>

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

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

4.1 Tables 1 and 4 indicate the number and nature of SLOs in each topic in classes XI and XII 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 (25% in XI and 32% in XII), Application and higher order skills (64% in XI and 62% 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 of duration of 3 hours.
- 4.4 Paper I theory will consist of 35 compulsory, multiple choice questions. These questions will involve four response options.
- 4.5 Paper II theory will carry 65 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
- Presentations
- Brainstorming
- Group discussion
- Concept building through using and developing low/no cost material

## **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. Ang Tok Woon, Cheah Tat Huat, Khor Gark Kim, Leong Wei Ching, Tan Beng Theam (1998) 5<sup>th</sup> Edition *Additional Mathematics*. Singapore: Oxford University Press.
2. Ross L. Finney and George B. Thomas JR, (1989) *Elements of Calculus and Analytic Geometry* United States of America: Addison Wesley Publishing Company.

## Recommended Websites

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

## 7. Definition of Cognitive Levels and Command Words

### 7.1 Definition of Cognitive Levels

#### 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, 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, identifying motives, finding evidence, etc. It can be taught and evaluated through questions based on: why, how, show, demonstrate, paraphrase, interpret, summarize, explain, prove, predict, compare, distinguish, discuss, chart the course/direction, report, 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, corroborate, compare and contrast, create, design, solve, formulate, integrate, rearrange, reconstruct/recreate, reorganize, predict consequences, etc.

### 7.2 Definition of Command Words

#### Knowledge

- Define:** Only a formal statement or equivalent paraphrase is required. No examples need to be given.
- Identify:** Pick out, recognizing specified information from a given content or situation.
- State:** To express the particulars of; to set down in detail or in gross; to represent fully in words; to narrate; to recite; as, to state the facts of a case, one's opinion, etc.
- Write:** To compose, execute or produce in words, characters or figures.

## Understanding

- Describe:** To state in words (using diagrams where appropriate) the main points of the topic.
- Deduce:** To derive or draw as a conclusion by reasoning from given conditions or principles.
- Discuss:** To give a critical account of the points involved in the topic.
- Distinguish:** To identify those characteristics which always or sometimes distinguish between two categories.
- Establish:** To prove correct or true on the basis of the previous examples.
- Explain:** To give reason or use some reference to theory, depending on the context.
- Illustrate:** To give clear examples to state, clarify or synthesize a point of view.
- Interpret:** To translate information from observation, charts, tables, graphs, and written material in a supportable manner.
- Prove:** To establish a rule or law by using an accepted sequence of procedures on statements.

## Application

- 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.
- Convert:** To change or adapt from one system or units to another.
- Derive:** To arrive at a general formula by calculating step by step.
- Determine:** To establish or ascertain definitely, as after consideration, investigation, or calculation
- Draw:** To make a simple freehand sketch or diagram. Care should be taken with proportions and the clear labelling of parts.
- Evaluate:** To judge or assess on the basis of facts, argument or other evidence to come to conclusion.
- Estimate:** To calculate approximately (the amount, extent, magnitude, position, or value of something).

- Expand:** To write (a quantity) as a sum of terms in an extended form.-
- 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.
- Investigate:** Thoroughly and systematically consider a given problem or a statement in order to find out the result or rule applied.
- 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.
- Use:** To deploy the required attribute in a constructed response.
- Verify:** To check or determine the correctness and accuracy of Laws or rules by investigation.

### HSSC Scheme of Studies<sup>3</sup>

AKU-EB as a national board offers SSC and HSSC qualifications for both English and Urdu medium schools. The revised HSSC Scheme of Studies issued by the Curriculum Wing was implemented from September 2007. The marks allocated to subjects in the revised National Scheme of Studies have been followed.

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

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

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-I	100	-	100	English
Urdu Compulsory-I <b>OR</b> Pakistan Culture-I <sup>a</sup>	100	-	100	Urdu English
Physics-I	85	15	100	English
Chemistry-I	85	15	100	English
Biology-I	85	15	100	English
<b>Total:</b>	<b>455</b>	<b>45</b>	<b>500</b>	

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

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-II	100	-	100	English
Urdu Compulsory-II <b>OR</b> Pakistan Culture-II <sup>a</sup>	100	-	100	Urdu English
Islamiyat <b>OR</b> Ethics <sup>b</sup>	50	-	50	English / Urdu
Pakistan Studies	50	-	50	English / Urdu
Physics-II	85	15	100	English
Chemistry-II	85	15	100	English
Biology-II	85	15	100	English
<b>Total:</b>	<b>555</b>	<b>45</b>	<b>600</b>	

- Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.
- For non-Muslim candidates in lieu of Islamiyat.

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

<sup>3</sup> Government of Pakistan September 2007. *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			Medium
	Theory	Practical	Total	
English Compulsory-I	100	-	100	English
Urdu Compulsory-I <b>OR</b> Pakistan Culture-I <sup>a</sup>	100	-	100	Urdu English
Physics-I	85	15	100	English
Chemistry-I	85	15	100	English
Mathematics-I	100	-	100	English
<b>Total:</b>	<b>470</b>	<b>30</b>	<b>500</b>	

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

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-II	100	-	100	English
Urdu Compulsory-II <b>OR</b> Pakistan Culture-II <sup>a</sup>	100	-	100	Urdu English
Islamiyat <b>OR</b> Ethics <sup>b</sup>	50	-	50	English / Urdu
Pakistan Studies	50	-	50	English / Urdu
Physics-II	85	15	100	English
Chemistry-II	85	15	100	English
Mathematics –II	100	-	100	English
<b>Total:</b>	<b>570</b>	<b>30</b>	<b>600</b>	

- a. Foreign students may opt for 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 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			Medium
	Theory	Practical	Total	
English Compulsory-I	100	-	100	English
Urdu Compulsory-I	100	-	100	Urdu
Pakistan Culture-I <sup>a</sup>				English
<b>Any one subject combinations of the following:</b>				
Physics-I	85	15	300	English
Mathematics-I	100	-		English
*Statistics-I	85	15		English
Economics-I	100	-	300	English / Urdu
Mathematics-I	100	-		English
*Statistics-I	85	15		English
Economics-I	100	-	300	English / Urdu
Mathematics-I	100	-		English
Computer Science-I	75	25		English
Physics-I	85	15	300	English
Mathematics-I	100	-		English
Computer Science-I	75	25		English
Mathematics-I	100	-	300	English
*Statistics-I	85	15		English
Computer Science-I	75	25		English
<b>Total:</b>			<b>500</b>	

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

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

a. Foreign students may opt for 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 Classes XI and XII, but the examination will be conducted at the end of Class XII.*

**\*These subject is offered ONLY in the May examination.**

**HSSC Part-I (Class XI) Commerce Group**

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-I	100	-	100	English
Urdu Compulsory-I <b>OR</b> Pakistan Culture-I <sup>a</sup>	100	-	100	Urdu English
Principles of Accounting-I	100	-	100	English
Principles of Economics	75	-	75	English
Principles of Commerce	75	-	75	English
Business Mathematics	50	-	50	English
<b>Total:</b>	<b>500</b>	<b>-</b>	<b>500</b>	

**HSSC Part-II (Class XII) Commerce Group**

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

- Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.
- For non-Muslim candidates in lieu of Islamiyat.

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

**\*This subjects are offered ONLY in the May examination.**



**HSSC Part-I (Class XI) Humanities Group**

Subjects	Marks	Medium
English Compulsory-I	100	English
Urdu Compulsory-I <b>OR</b> Pakistan Culture-I <sup>a</sup>	100	Urdu English
<b>Any three of the following Elective Subjects</b>	300	
1. Civics-I	(100	English / Urdu
2. Computer Science-I (75+25 practical)	each)	English
3. Economics-I		English / Urdu
4. *Education-I		English / Urdu
5. *Geography-I (85+15 practical)		English / Urdu
6. *Islamic Studies-I		English / Urdu
7. *Islamic History-I		English / Urdu
8. Literature in English-I		English
9. Mathematics-I		English
10. *Psychology-I (85+15 practical)		English / Urdu
11. *Statistics-I (85+15 practical)		English
12. *Sociology-I		English / Urdu
13. Urdu Literature-I		Urdu
14. *Fine Arts-I		English
<b>Total:</b>	<b>500</b>	

**HSSC Part-II (Class XII) Humanities Group**

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

- a. Foreign students may opt for 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 Classes XI and XII, but the examination will be conducted at the end of Class XII.*

**\*These subjects are offered ONLY in the May examination.**