



آغا خان یونیورسٹی ایگزامینیشن بورڈ

AGA KHAN UNIVERSITY EXAMINATION BOARD

**Secondary School Certificate
Examination Syllabus**

**ADDITIONAL
MATHEMATICS
CLASSES IX-X**

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**ADDITIONAL
MATHEMATICS
CLASSES IX-X**

**This subject is examined in the
May Examination session only**

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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 seeks to broaden the learning horizons for students by providing a broad-based learning framework through developing new examination syllabi.

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 brings together all those cognitive outcomes 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 that are essential for commitment to lifelong learning.

To achieve this end AKU-EB has brought together university academics, 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 text book 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.

We stand committed to all students entering the SSC course as well as those who have recently embarked upon the HSSC course in facilitating their learning outcome. Our examination syllabus document ensures all possible support.



Dr. Thomas Christie
Director,
Aga Khan University Examination Board
August 2011

1. Rationale of the AKU-EB Examination Syllabus

1.1 General Rationale

- 1.1.1 AKU-EB Syllabus is a guide to the teachers and students that at which cognitive level or levels (Knowledge, Understanding, Application and other higher order skills) the topics and sub-topics will be taught and examined; 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 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.
- 1.1.2 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.
- 1.1.3 The Student Learning Outcomes (SLOs) in Section 2 start with command words such as solve, describe, relate, draw, 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 6. It is hoped that teachers will find these definitions useful in planning their lessons and classroom assessments.
- 1.1.4 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 purpose of this newly designed syllabus has been fully met. The weighting of marks to the Multiple Choice and Constructed Response Papers is also derived from the SLOs, command words and cognitive levels.

1.2. Specific Rationale of the AKU-EB Additional Mathematics Examination Syllabus

- 1.2.1 The teaching of Additional 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.
- 1.2.2 It is intended to reduce the gap between O level and Secondary level mathematics by introducing those topics which are part of O level syllabus but not the part of the SSC syllabus.
- 1.2.3 It is planned in a way to offer an easy transition from SSC level to HSSC level by providing learners a chance to familiarize them to higher level techniques in advance which are closer to SSC level in terms of difficulty. This will enable the students to enhance their basics mathematical skills to attain suitable foundation for further study of mathematics and related fields. Therefore, they will be better prepared for their college studies. This guidance will help both teachers and students to prepare for the AKU-EB examination leading to increased student achievements.

3. Topics and Student Learning Outcomes of the Examination Syllabus

Part I (Class IX)

Topics	Student Learning Outcomes		Cognitive Levels ¹		
			K	U	A
1. Estimation and Approximation	Candidates should be able to:				
1.1 Approximation in Measurement and Accuracy	1.1.1	describe the upper bound and the lower bound to specify the limit of accuracy;		*	
	1.1.2	find the appropriate upper bound and lower bound to solve simple problems;			*
	1.1.3	solve problems related to upper bound and lower bound;			*
1.2 Significant Figures	1.2.1	describe significant figures;		*	
	1.2.2	apply the rules for determining the number of significant figures/digits;			*
	1.2.3	describe the rules for rounding a number to a given number of significant figures/ digits;		*	
	1.2.4	apply the rules for rounding a number to given number of significant figures to solve problems.			*

¹ K = Knowledge, U = Understanding, A= Application (for explanation see Section 6: Definition of command words used in Student Learning Outcomes and in Examination Questions).

NOTES

			K	U	A
2. Solution of Simultaneous Equations	Candidates should be able to:				
2.1 Simultaneous Equations in Two Unknowns or Variables	2.1.1	solve simultaneous equations in two variables when: i. both the equations are linear ii. one equation is linear and other is quadratic;			*
	2.1.2	explain the solution of simultaneous equations as points of intersection of a line and a curve;		*	
	2.1.3	solve word problems based on the above mentioned concepts.			*
3. Functions	Candidates should be able to:				
3.1 Function and Composition of Functions	3.1.1	describe function and composition of functions and their symbols;		*	
	3.1.2	find the composite function of two given functions and find the value of the composite function at a given point;			*
3.2 Inverse of a Function	3.2.1	describe the inverse of a one-one function ;		*	
	3.2.2	find the inverse of a function and its value at a given value of the variable; e.g. $f(x) = \frac{ax + b}{c}$ where $a \neq 0$ and $c \neq 0$ or $f(x) = \frac{ax + b}{cx + d}$, where $cx + d \neq 0$;			*
3.3 Graph of a Function	3.3.1	sketch the graphs of functions like $f(x) = ax + b$, $f(x) = ax^2 + bx + c$ $f(x) = ax + b $, $f(x) = \frac{c}{ax + b}$, $f(x) = \frac{c}{ax^2 + b}$, $f(x) = ax^2 + bx + c $;		*	
		3.3.2	investigate the graphs of function and non function on the basis of vertical line test and one-one function on the basis of horizontal line test;		
	3.3.3	sketch the graph of transformed functions $y = f(x \pm k)$, $y = f(x) \pm k$ $y = f(-x)$, $y = -f(x)$, $y = f(kx)$ and $y = kf(x)$.		*	

NOTES

			K	U	A
4. Limits	Candidates should be able to:				
4.1 Limits of Algebraic Functions	4.1.1	explain the meaning of the phrase ' x tends to a or x approaches to a i.e. ($x \rightarrow a$), where a is a finite number;		*	
	4.1.2	describe the limit of a function;		*	
	4.1.3	find the limits of different algebraic functions;			*
	4.1.4	state the theorems of limits for sum, difference, power, product and quotient of functions;	*		
	4.1.5	apply the above theorems to find the limit.			*
5. Coordinate Geometry	Candidates should be able to:				
5.1 Distance Formula and Midpoint Formula	5.1.1	describe rectangular or Cartesian plane;		*	
	5.1.2	locate an ordered pair (a, b) as a point in the rectangular plane;		*	
	5.1.3	apply distance formula to calculate distance between two points given in the Cartesian plane;			*
	5.1.4	apply midpoint formula to find the midpoint of the line segment joining the two given points;			*
5.2 Slope of a Straight Line	5.2.1	define the slope of a line;	*		
	5.2.2	illustrate the slope of a line graphically;		*	
	5.2.3	discuss the nature of slope;		*	
	5.2.4	calculate the slope of a line passing through the two points;			*
	5.2.5	apply the condition that the two straight lines with the given slopes are: i. parallel to each other ii. perpendicular to each other;			*

NOTES

			K	U	A
5.3	Standard and Other Forms of an Equation of Straight Line	5.3.1 find the equation of a straight line parallel to x -axis or y -axis; 5.3.2 interpret the meaning of intercepts of a straight line; 5.3.3 describe the equation of a straight line in slope intercept form($ y = mx + c $), point slope form $ y - y_1 = m(x - x_1) $, two points form $ \frac{y - y_1}{x - x_1} = \frac{y_2 - y_1}{x_2 - x_1} $ and intercepts form $ \frac{x}{a} + \frac{y}{b} = 1 $; 5.3.4 find the equation of straight line by using the above mentioned conditions; 5.3.5 convert the general form of the equation of straight line (i.e. $ ax + by + c = 0 $) in other forms; 5.3.6 find the equation of medians, altitudes and right bisectors of a triangle; 5.3.7 solve problems based on the above mentioned concepts .		* *	* * * * *
6. Applications of Graph in Practical Situations		Candidates should be able to:			
6.1	Applications of Graph	6.1.1 use and interpret line graphs in practical situations e.g. conversion graph, travel graph, etc; 6.1.2 draw a graph from the given data; 6.1.3 explain the idea of the rate of change involving distance-time graphs and speed-time graphs; 6.1.4 find the distance travelled ,velocity, acceleration and retardation with the help of the given graphs. 6.1.5 solve problems related to the above mentioned concepts.		*	* * * *

NOTES

			K	U	A
7. Isometric Transformations	Candidates should be able to:				
7.1 Transformation and its Types	7.1.1	define the term transformation;	*		
	7.1.2	distinguish between isometric and non- isometric transformations;		*	
7.2 Translation	7.2.1	illustrate translation with the help of diagrams;		*	
	7.2.2	translate an object(point, line segment, triangle and quadrilateral etc.) under a translation T by using $\begin{pmatrix} x \\ y \end{pmatrix} + T = \begin{pmatrix} x' \\ y' \end{pmatrix}$ to find the coordinates of image and draw translated image of the object on a graph paper;			*
7.3 Reflection	7.3.1	describe reflection and axis of reflection (axis of symmetry or mirror line);		*	
	7.3.2	find the coordinates of a point under reflection ;			*
	7.3.3	find the axis of reflection and its equation;			*
	7.3.4	find the equation of image of a line $y = m x + c$ when the line of reflection is $x - axis$, $y - axis$, $x = constant$ and $y = constant$;			*
	7.3.5	find the coordinates of vertices of an image under reflection line $x - axis$, $y - axis$ and $y = m x + c$, when the coordinates of vertices of an object are given;			*
	7.3.6	draw reflected image of an object when mirror line is $x - axis$, $y - axis$ and $y = m x + c$ on a graph paper;			*
7.4 Rotation	7.4.1	describe rotation (centre of rotation and angle of rotation);		*	
	7.4.2	rotate an object about origin through $90^\circ, 180^\circ, 270^\circ$ clockwise and anticlockwise(counter clockwise) and illustrate the situation with the help of a diagram;			*
	7.4.3	find the centre and the angle of rotation when an object and image are given;			*
	7.4.4	investigate the different types of isometric transformations.			*

NOTES

Part II (Class X)

Topics	Student Learning Outcomes		Cognitive Levels		
			K	U	A
8. Quadratic Equations and Quadratic Functions	Candidates should be able to:				
8.1 Solution of Quadratic Equations	8.1.1	solve quadratic equations in one variable by: i. factorisation method ii. completing the square method iii. quadratic formula;			*
8.2 Nature of Roots of Quadratic Equation	8.2.1	define discriminant $(b^2 - 4ac)$ of the quadratic equation $ax^2 + bx + c = 0$, where $a \neq 0$;	*		
	8.2.2	determine the nature of roots of a given quadratic equation through discriminant and verify the result by solving the equation;			*
	8.2.3	illustrate the nature of roots of a quadratic equation graphically;		*	
	8.2.4	find the relationship between the roots and the coefficient of a quadratic equation;			*
	8.2.5	find the sum and product of the roots of a given quadratic equation without solving it;			*
	8.2.6	solve problems based on the sum and the product of the roots;			*
	8.2.7	find a quadratic equation whose roots are given;			*
	8.2.8	establish the formula: $x^2 - (\text{sum of roots})x + (\text{product of roots}) = 0$ to find a quadratic equation from the given roots;		*	
	8.2.9	use the formula to find a quadratic equation from the given roots;			*

NOTES

			K	U	A	
8.3	Quadratic Functions and their Characteristics	8.3.1	define the general form of quadratic function i.e. $y = f(x) = ax^2 + bx + c ; a \neq 0 ;$	*		
		8.3.2	illustrate the terms concavity, vertex, minimum and maximum value of quadratic function, x – intercept(s) and y – intercept(s);		*	
		8.3.3	find the concavity, vertex, minimum and maximum value, x – intercept(s), y – intercept(s) and sketch the quadratic functions;			*
		8.3.4	solve problems based on the above mentioned concepts.			*
9. Trigonometry		Candidates should be able to:				
9.1	Trigonometric Ratios of Complementary Angles	9.1.1	describe the relationship between trigonometric ratios of complementary angles i.e. $\sin(90 - \theta) = \cos \theta$, $\cos(90 - \theta) = \sin \theta$ and $\tan(90 - \theta) = \frac{1}{\tan \theta}$;		*	
		9.1.2	apply the above mentioned relations to solve problems;			*
9.2	General Angles and their Signs in Different Quadrants	9.2.1	identify the general angles (e.g. $\pm 30^\circ, \pm 45^\circ, \pm 60^\circ, \pm 90^\circ, \pm 120^\circ, \pm 150^\circ, \pm 180^\circ, \pm 270^\circ, \pm 300^\circ, \pm 360^\circ, \pm 450^\circ$ etc);	*		
		9.2.2	identify quadrants and quadrantal angles (90° , 180° , 270° and 360°);		*	
		9.2.3	write the values of trigonometric ratios of sine, cosine ,tangent, cosecant, secant and cotangent of 0° , 30° , 45° , 60° , 90° , 180° , 270° and 360° ;	*		
		9.2.4	identify the signs of trigonometric ratios in different quadrants ;		*	
		9.2.5	find the values of remaining trigonometric ratios if one of the trigonometric ratio is given;			*

NOTES

			K	U	A
9.3	Graphs of Trigonometric Functions	9.3.1	sketch the graphs of : $a \sin bx + c = 0$; $a \cos bx + c = 0$, $a \tan bx + c = 0$, $0^\circ \leq x \leq 360^\circ$ and $0 \leq x \leq 2\pi$ where a , b and c are constants and belong to integers;		
		9.3.2	*	*	
		9.3.3			*
		9.3.4		*	
10. Circular Measures		Candidates should be able to:			
10.1	Radian and Degree Measures	10.1.1	*		
		10.1.2			*
10.2	Arc Length and Area of Circular Sector	10.2.1		*	
		10.2.2			*
		10.2.3		*	
		10.2.4			*
10.3	Solution of Oblique Triangles and their Area	10.3.1	*		
		10.3.2		*	
		10.3.3			*
		10.3.4		*	
		10.3.5			*
10.4	Applications	10.4.1			*

NOTES

			K	U	A
11. Counting Techniques		Candidates should be able to:			
11.1 Basic Counting Principle	11.1.1	apply the fundamental principle of counting in different situations;			*
	11.1.2	illustrate the fundamental principle of counting using tree diagram;		*	
	11.1.3	explain the concept of the product of the first n natural numbers as $n!$ (Krampe's factorial) and fact $0! = 1$;		*	
11.2 Permutations and Combinations	11.2.1	explain the meaning of permutation of n different objects taken r at a time and recognize the notation ${}^n P_r$;		*	
	11.2.2	explain the meaning of combination of n different objects taken r at a time and recognize the notation ${}^n C_r$;		*	
	11.2.3	distinguish between a permutation (arrangement) and a combination (selection);		*	
	11.2.4	solve problems involving permutation and combination (excluding circular permutation).			*
12. Probability Concepts		Candidates should be able to:			
12.1 Probability and its applications	12.1.1	describe the terms: experiment, sample space (all possible outcomes), an event, simple and compound events, equally likely events, exhaustive events, mutually exclusive, mutually non-exclusive events and probability of an event;		*	
	12.1.2	apply the formula for the probability of occurrence of an event E that is $P(E) = \frac{n(E)}{n(S)}, 0 \leq P(E) \leq 1;$			*
	12.1.3	apply the formula for finding the probability in simple and compound cases (with and without replacement);			*
	12.1.4	describe the law of addition of probability $P(A \cup B) = P(A) + P(B) - P(A \cap B);$		*	

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			K	U	A
	12.1.5	deduce that $P(A \cup B) = P(A) + P(B)$, where A and B are mutually exclusive events;		*	
	12.1.6	describe the law of multiplication of probability $P(A \cap B) = P(A) \times P(B)$;		*	
	12.1.7	apply the law of addition and multiplication of probability to solve related problems;			*
	12.1.8	apply Venn diagram to illustrate and solve problems based on the probability.			*
13. Vectors in Two Dimensions	Candidates should be able to:				
13.1 Basic Concepts of Vectors	13.1.1	describe scalar quantity, vector quantity, equal vectors, negative vector, column vector, unit vector, zero vector and magnitude of a vector;		*	
	13.1.2	representation of a vector symbolically and graphically;		*	
13.2 Operations on Vectors	13.2.1	describe the addition and subtraction of vectors graphically;		*	
	13.2.2	solve problems based on addition and subtraction of vectors;			*
	13.2.3	describe the multiplication of a vector by a scalar, when the scalar is positive or negative;		*	
	13.2.4	describe the scalar product of two vectors;		*	
	13.2.5	solve problems based on the scalar product of vectors.			*

NOTES

			K	U	A
14. Differentiation	Candidates should be able to:				
14.1 Concept of Differentiation	14.1.1	distinguish between an average rate of change and an instantaneous rate of change;		*	
	14.1.2	explain the derivative as an instantaneous rate of change;		*	
	14.1.3	illustrate the concept of derivative as tangent to the curve;		*	
	14.1.4	find the derivative of algebraic functions of the types $y = x^n$ and $y = (ax^m + bx + c)^n$, where a, b, m and n are constants;			*
	14.1.5	find the derivative of the trigonometric functions, exponential functions and logarithmic functions ;			*
14.2 Product and Quotient Rules	14.2.1	find the derivative of sum and difference of functions, product of two functions (product rule) and quotient functions (quotient rule);			*
14.3 Equations of Tangent and Normal to a Curve	14.3.1	apply differentiation to find the equations of the tangent and the normal to a curve.			*

NOTES

		K	U	A
15. Integration (Anti-differentiation)	Candidates should be able to:			
15.1 Concept of Integration	15.1.1 describe integration; 15.1.2 distinguish between definite and indefinite integrals; 15.1.3 find the indefinite integrals to relate simple standard integrals formula from standard differentiation formulae;		*	*
15.2 Rules of Integration	15.2.1 describe the following rules of integration: i. $\int x^n dx = \frac{x^{n+1}}{n+1} + c$, where $n \neq -1$ ii. $\int (ax+b)^n dx = \frac{(ax+b)^{n+1}}{a(n+1)} + c$, where $n \neq -1$ iii. $\int af(x)dx = a \int f(x)dx$ iv. $\int [f(x) \pm g(x)]dx = \int f(x)dx \pm \int g(x)dx$; 15.2.2 apply the above mentioned rules of integration to solve problems; 15.2.3 describe definite integrals as the area under the curve; 15.2.4 apply definite integrals to calculate the area under the curve; 15.2.5 apply differentiation and integration in kinematics problems that involve displacement, velocity and acceleration of a particle.			*

NOTES

3. Scheme of Assessment

Class IX

Table 1: Number of Student Learning Outcomes by Cognitive Level

Topic No.	Topics	No. of Sub-topics	SLOs			Total
			K	U	A	
1.	Estimation and Approximation	2	0	3	4	7
2.	Solution of Simultaneous Equations	1	0	1	2	3
3.	Functions	3	0	4	3	7
4.	Limits	1	1	2	2	5
5.	Co-ordinate Geometry	3	1	6	9	16
6.	Applications of Graph in Practical Situations	1	0	1	4	5
7.	Isometric Transformations	4	1	4	9	14
	Total	15	3	21	33	57
	Percentage		5	37	58	100

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.	Estimation and Approximation	2	2	4	6
2.	Solution of Simultaneous Equations	1	2	7	9
3.	Functions	3	3	8	11
4.	Limits	1	2	6	8
5.	Co-ordinate Geometry	3	4	12	16
6.	Applications of Graph in Practical Situations	1	3	8	11
7.	Isometric Transformations	3	4	10	14
	Total	14	20	55	75

Table 3: Paper Specifications

Topic No.	Topics	Marks Distribution		Total Marks
1.	Estimation and Approximation	MCQs 2 @ 1 Mark *CRQs 2 @ 4 Marks each Choose any ONE from TWO		6
2.	Solution of Simultaneous Equations	MCQs 2 @ 1 Mark CRQ 1 @ 7 Marks		9
3.	Functions	MCQs 3 @ 1 Mark **CRQs 3 @ 4 Marks each Choose any TWO from THREE		11
4.	Limits	MCQs 2 @ 1 Mark CRQ 1 @ 6 Marks		8
5.	Co-ordinate Geometry	MCQs 4 @ 1 Mark **CRQs 3 @ 6 Marks each Choose any TWO from THREE		16
6.	Applications of Graph in Practical Situations	MCQs 3 @ 1 Mark CRQ 1 @ 8 Marks		11
7.	Isometric Transformations	MCQs 4 @ 1 Mark **CRQs 3 @ 5 Marks each Choose any TWO from THREE		14
Total		MCQs 20	CRQs 55	75

* 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.

Class X

Table 4: Number of Student Learning Outcomes by Cognitive Level

Topic No.	Topics	No. of Sub-topics	SLOs			Total
			K	U	A	
8.	Quadratic Equations and Quadratic Functions	3	2	3	8	13
9.	Trigonometry	4	4	7	5	16
10.	Circular Measures	4	2	4	6	12
11.	Counting Techniques	2	0	5	2	7
12.	Probability Concepts	1	0	4	4	8
13.	Vectors in two Dimensions	2	0	5	2	7
14.	Differentiation	3	0	3	4	7
15.	Integration (Anti-Differentiation)	2	0	2	6	8
	Total	21	8	33	37	79
	Percentage		10	42	48	100

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

Topic No.	Topics	No. of Sub-Topics	Marks		Total
			Multiple Choice Questions	Constructed Response Questions	
8.	Quadratic Equations and Quadratic Functions	3	3	8	11
9.	Trigonometry	3	3	5	8
10.	Circular Measures	4	2	10	12
11.	Counting Techniques	2	2	3	5
12.	Probability Concepts	1	2	5	7
13.	Vectors in two Dimensions	2	2	4	6
14.	Differentiation	3	3	10	13
15.	Integration (Anti-Differentiation)	2	3	10	13
	Total	20	20	55	75

Table 6: Paper Specifications

Topic No.	Topics	Marks Distribution		Total Marks
8.	Quadratic Equations and Quadratic Functions	MCQs 3 @ 1 Mark **CRQs 3 @ 4 Marks each Choose any TWO from THREE		11
9.	Trigonometry	MCQs 3 @ 1 Mark CRQ 1 @ 5 Marks		8
10.	Circular Measures	MCQs 2 @ 1 Mark **CRQs 3 @ 5 Marks each Choose any TWO from THREE		12
11.	Counting Techniques	MCQs 2 @ 1 Mark *CRQs 2 @ 3 Marks each Choose any ONE from TWO		5
12.	Probability Concepts	MCQs 2 @ 1 Mark *CRQs 2 @ 5 Marks each Choose any ONE from TWO		7
13.	Vectors in two Dimensions	MCQs 2 @ 1 Mark CRQ 1 @ 4 Marks		6
14.	Differentiation	MCQs 3 @ 1 Mark **CRQs 3 @ 5 Marks each Choose any TWO from THREE		13
15.	Integration (Anti-Differentiation)	MCQs 3 @ 1 Mark **CRQs 3 @ 5 Marks each Choose any TWO from THREE		13
Total		MCQs 20	CRQs 55	75

* 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.

3.1 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 (37% in IX and 42% in X), Application and higher order skills (58% in IX and 48% in X) to discourage rote memorization. Tables 1 and 4, however, do not translate directly into marks.

3.2 There will be two examinations, one at the end of Class IX and one at the end of Class X.

3.3 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.

- 3.4 Paper I theory will consist of 20 compulsory, multiple choice questions. These questions will involve four response options.
- 3.5 Paper II theory will carry 55 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.
- 3.6 All constructed response questions will be in a booklet which will also serve as an answer script.

4. Teaching-Learning Approaches and Classroom Activities

- 4.1 As the AKU-EB syllabus focuses on understanding and higher order thinking skills, teachers need to encourage activity and problem-based classroom practices.
- 4.2 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

5. Recommended Texts, Reference Materials

Recommended Book

1. Woon T. Ang, et al., (2003). *Fifth Edition A Course For O-Level Pure Mathematics (Additional Mathematics)*. Singapore: Federal Publications.

Reference Books

1. Teh K. Seng and Loh C. Yee (2007). *Fifth Edition New Syllabus Mathematics 4*. Karachi: Oxford University Press.
2. Teh K. Seng and Loh C. Yee (2007). *Fifth Edition New Syllabus Mathematics 2*. Karachi: Oxford University Press.
3. Punjab Textbook Board (2007). *Mathematics for Class XI*. Lahore: Punjab Textbook Board.
4. Punjab Textbook Board (2007). *Mathematics for Class XII*. Lahore: Punjab Textbook Board.

Chapter Wise Suggested Reading

Topic No.	Topic	Suggested Reading
1.	Estimation and Approximation	Teh K. Seng and Loh C. Yee (2007). <i>Fifth Edition New Syllabus Mathematics 1</i> . Karachi: Oxford University Press.
2.	Solution of Simultaneous Equations	Chapter 2 Wo Woon T. Ang, et al., (2003). <i>Fifth Edition A Course For O-Level Pure Mathematics (Additional Mathematics)</i> . Singapore: Federal Publications. On T. Ang, et al., (2003). <i>Fifth Edition A Course For O-Level Pure Mathematics (Additional Mathematics)</i> . Singapore: Federal Publications.
3.	Functions	Chapter 3 Woon T. Ang, et al., (2003). <i>Fifth Edition A Course For O-Level Pure Mathematics (Additional Mathematics)</i> . Singapore: Federal Publications.
4.	Limits	Chapter 1 Punjab Textbook Board (2007). <i>Mathematics for Class XII</i> . Lahore: Punjab Textbook Board.
5.	Co-ordinate Geometry	Chapter 1 Woon T. Ang, et al., (2003). <i>Fifth Edition A Course For O-Level Pure Mathematics (Additional Mathematics)</i> . Singapore: Federal Publications. Chapter 4 Page # 179 to Page # 204 Punjab Textbook Board (2007). <i>Mathematics for Class XII</i> . Lahore: Punjab Textbook Board.
6.	Applications of Graph in Practical Situations	Chapter 9 Page # 154 to Page # 156 Teh K. Seng and Loh C. Yee (2007). <i>Fifth Edition New Syllabus Mathematics 2</i> . Karachi: Oxford University Press.
7.	Isometric Transformations	Chapter 4 Teh K. Seng and Loh C. Yee (2007). <i>Fifth Edition New Syllabus Mathematics 4</i> . Karachi: Oxford University Press.
8.	Quadratic Equations and Quadratic Functions	Chapter 4 Woon T. Ang, et al., (2003). <i>Fifth Edition A Course For O-Level Pure Mathematics (Additional Mathematics)</i> . Singapore: Federal Publications.

Topic No.	Topic	Suggested Reading
9.	Trigonometry	Chapter 8 Woon T. Ang, et al., (2003). <i>Fifth Edition A Course For O-Level Pure Mathematics (Additional Mathematics)</i> . Singapore: Federal Publications. <ul style="list-style-type: none"> Page # 361 to Page # 376 Punjab Textbook Board (2007). <i>Mathematics for Class XI</i>. Lahore: Punjab Textbook Board.
10.	Circular Measure	Chapter 7 Woon T. Ang, et al., (2003). <i>Fifth Edition A Course For O-Level Pure Mathematics (Additional Mathematics)</i> . Singapore: Federal Publications.
11.	Counting Techniques	<ul style="list-style-type: none"> Page # 231 to page # 255 Punjab Textbook Board (2007). <i>Mathematics for Class XI</i>. Lahore: Punjab Textbook Board.
12.	Probability Concepts	
13.	Vectors in two Dimensions	Chapter 21 Woon T. Ang, et al., (2003). <i>Fifth Edition A Course For O-Level Pure Mathematics (Additional Mathematics)</i> . Singapore: Federal Publications.
14.	Differentiation	Chapter 10, 11 ,14 and 15 Woon T. Ang, et al., (2003). <i>Fifth Edition A Course For O-Level Pure Mathematics (Additional Mathematics)</i> . Singapore: Federal Publications.
15.	Integration (Anti-Differentiation)	Chapter 12 Woon T. Ang, et al., (2003). <i>Fifth Edition A Course For O-Level Pure Mathematics (Additional Mathematics)</i> . Singapore: Federal Publications.

Recommended 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.mathstorie.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.teachingmadeeasier.com/math.html
The MathWorks (MATLAB)	http://www.mathworks.com
Webmath	http://www.webmath.com/

6. Definition of Cognitive Levels and Command Words

6.1 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.

6.2 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.
- Locate:** To place or to set in a particular spot or position.
- Prove:** To establish a rule or law by using an accepted sequence of procedures on statements.
- Represent:** To indicate by signs or symbols or to establish a mapping (of mathematical elements or sets).
- Sketch:** To make a simple freehand sketch or diagram. Care should be taken with proportions and the clear labelling of parts.

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.
- Draw:** To make a simple freehand sketch or diagram. Care should be taken with proportions and the clear labelling of parts.

- 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.
- Rotate:** To turn or cause to turn around an axis, line, or point; revolve or spin.
- Solve:** To work out systematically the answer of a given problem.
- Translate:** To transform an object and moved to another location without any change in size or orientation.
- Use:** To deploy the required attribute in a constructed response.

SSC Scheme of Studies²

AKU-EB as a national board offers SSC and HSSC qualifications for both English and Urdu medium schools. The revised SSC Scheme of Studies issued by the Curriculum Wing was implemented from September 2007. Accordingly, each SSC subject will be taught across both the classes IX and X. The Science and Humanities group subjects are offered at SSC level. The marks allocated to subjects in the revised National Scheme of Studies of September 2007 have been followed.

SSC I and II (Class IX and X) subjects on offer for examination**SSC Part-I (Class IX) Science Group**

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-I	75	-	75	English
Urdu Compulsory-I OR Urdu Aasan ^a OR History and Geography of Pakistan-I ^b	75	-	75	Urdu Urdu English
Islamiyat-I OR Ethics-I ^c	*30	-	*30	English / Urdu
Pakistan Studies-I	*45	-	*45	English / Urdu
Mathematics-I	75	-	75	English / Urdu
Physics-I	65	10	75	English / Urdu
Chemistry-I	65	10	75	English / Urdu
Biology-I OR Computer Science-I	65	10	75	English / Urdu English
Total:	*495	30	*525	

SSC Part-II (Class X) Science Group

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-II	75	-	75	English
Urdu Compulsory-II OR Sindhi ^a OR History and Geography of Pakistan-II ^b	75	-	75	Urdu Sindhi English
Islamiyat-II OR Ethics-II ^c	*45	-	*45	English / Urdu
Pakistan Studies-II	*30	-	*30	English / Urdu
Mathematics-II	75	-	75	English / Urdu
Physics-II	65	10	75	English / Urdu
Chemistry-II	65	10	75	English / Urdu
Biology-II OR Computer Science-II	65	10	75	English / Urdu English
Total:	*495	30	*525	

- a. Candidates from the province of Sindh may appear in "Urdu Aasan" in SSC Part I and in "Sindhi" in Part II examination.
- b. Foreign students may opt HISTORY and GEOGRAPHY OF PAKISTAN in lieu of Urdu Compulsory, subject to the Board's approval.
- c. For non-Muslim candidates only.
- * The above will be implemented in
SSC Part I 2013 Examinations and onwards
SSC Part II 2014 Examinations and onwards

² Government of Pakistan September 2007. *Scheme of Studies for SSC and HSSC (Classes IX-XII)*. Islamabad: Ministry of Education, Curriculum Wing.

SSC Part-I (Class IX) Humanities Group

Subjects	Marks	Medium
English Compulsory-I	75	English
Urdu Compulsory-I OR Urdu Aasan ^a OR History and Geography of Pakistan-I ^b	75	Urdu Urdu English
Islamiyat-I OR Ethics-I ^c	*30	English / Urdu
Pakistan Studies-I	*45	English / Urdu
General Mathematics-I	75	English / Urdu
Any three of the following Elective Subjects	225 (75 each)	
1. **Geography-I		English / Urdu
2. General Science-I		English / Urdu
3. Computer Science-I (65+10 practical)		English
4. Economics-I		English / Urdu
5. Civics-I		English / Urdu
6. **History of Pakistan-I		English / Urdu
7. **Elements of Home Economics-I		English / Urdu
8. **Food and Nutrition-I (65+10 practical)		English / Urdu
9. **Art & Model Drawing-I		English
10. **Business Studies-I		English
11. **Environmental Studies-I		English
Total:	*525	

SSC Part-II (Class X) Humanities Group

Subjects	Marks	Medium
English Compulsory-II	75	English
Urdu Compulsory-II OR Sindhi ^a History and Geography of Pakistan-II ^b OR	75	Urdu Sindhi English
Islamiyat-II OR Ethics-II ^c	*45	English / Urdu
Pakistan Studies-II	*30	English / Urdu
General Mathematics-II	75	English / Urdu
Any three of the following Elective Subjects	225 (75 each)	
1. **Geography-II		English / Urdu
2. General Science-II		English / Urdu
3. Computer Science-II (65+10 practical)		English
4. Economics-II		English / Urdu
5. Civics-II		English / Urdu
6. **History of Pakistan-II		English / Urdu
7. **Elements of Home Economics-II		English / Urdu
8. **Food and Nutrition-II (65+10 practical)		English / Urdu
9. **Art & Model Drawing-II		English
10. **Business Studies-II		English
11. **Environmental Studies-II		English
Total:	*525	

SSC Part-I and Part-II (Class IX-X) (Additional Subjects)

SSC Part I	SSC Part II	Marks	Medium
1. **Literature in English-I ^d	1. **Literature in English-II ^d	75 each	English
2. **Commercial Geography-I ^d	2. **Commercial Geography-II ^d		English
3. **Additional Mathematics-I ^d	3. **Additional Mathematics-II ^d		English

a. Candidates from the province of Sindh may appear in "Urdu Aasan" in SSC Part I and in "Sindhi" in Part II examination.

b. Foreign students may opt HISTORY and GEOGRAPHY OF PAKISTAN in lieu of Urdu Compulsory, subject to the Board's approval.

c. For non-Muslim candidates only.

d. Subject will be offered as Additional Subject.

* The above will be implemented in

SSC Part I 2013 Examinations and onwards

SSC Part II 2014 Examinations and onwards

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