Federal Democratic Republic of Ethiopia
Industry of Education

Mathematics Syllabus, Grades 11 and 12

2009

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General Introduction

Mathematics learning at the second cycle of secondary education (Grades 11 and 12) should contribute to the students' growth into good, balanced and educated individuals and members of society. At this cycle, they should acquire the necessary mathematical knowledge and develop skills and competencies needed in their further studies, working life, hobbies, and all-round personal development. Moreover the study of mathematics at this level shall significantly contribute to the students' lifelong learning and self development throughout their lives. These aims can be realized by closely linking mathematics learning with daily life, relating theory with practice; paying attention to the practical application of mathematical concepts, theorems, methods and procedures by drawing examples from the fields of agriculture, industry and sciences like physics, chemistry and engineering.

Mathematics study in grades 11 and 12 should be understood as the unity of imparting knowledge, developing abilities and skills and forming convictions, attitudes and habits. Therefore, the didactic-methodical conception has to contribute to all these sides of the educational process and to consider the specifics of students' age, the function of the secondary school level in the present and prospective developmental state of the country, the pre-requisites of the respective secondary school and the guiding principles of the subject mathematics.

- In determining the general methodical approach of topics or special teaching methods for single periods, due consideration has always to be given to the **orientation of the main objectives**:
  - acquisition of solid knowledge on mathematical concepts, theorems, rules and methods assigned in the syllabus.
  - acquisition of reliable capability in working with this knowledge more independently in the field of problem solving.

The main activity for achieving these objectives includes engaging student in mental activity during classroom learning.

- Teaching has to consider students' interest that is related to their range of experience, actual events of the country and local reality so as to help them answer questions originating from daily life

- Problem solving is a suitable means for engaging students in mental activity. This has to be understood as a complex process, including the activities of the teachers and students. A teacher can be engaged in selecting or arranging the problems, planning their use in the classroom and organizing the process of solving problems while the students are engaged in solving the problems and in checking the results gained.

- While planning and shaping classroom learning the teacher has to observe that the application of newly acquired knowledge and capability is a necessary part in the process of complete recognition and solid acquisition of the new subject matter. Thus, application has to be carried out during presentation and stabilization.

- Introduction to a new topic and presentation of new subject matter have to be carried out using knowledge and experiences of students by encouraging students to actively participate in the teaching learning process by familiarizing students with the new subject matter and help them to understand and appreciate its use.

- Stabilization has to be understood as the fundamental process of mathematics learning. It has to be regarded as a principle of shaping in all stages of teaching and as precondition for mental activity of students and the enhancement of capabilities applying knowledge more independently.

- Within the total process of stabilization, exercising (in relation with revision, deepening and systematization) hold a central position. In mathematics, exercising is to be understood in a wider sense. In the first place, it is aimed at the formation of skills; but it is also oriented towards fixing knowledge (including subject matter dealt with previously) and habituating to certain modes of working and practising behavior. Furthermore last exercising has to facilitate the development of definite strategies of problems solving, being relatively independent of subject matter. Shaping of exercises has to be concentrated on assigning sufficient time, analyzing the real performances of students overcoming weak points of knowledge and capability, using all fundamental forms of exercises (daily activity, miscellaneous and complex exercises) systematically.

- Under the aspect of Students' preparation for Tertiary Education, it is necessary to prepare them step by step for mastering these demands. So, in shaping the teaching-learning process priority has to be given to methods which promote students' activities of cognition and reduce their mechanical rote learning. Students have to be asked, for instance, to report ways of solving a problem they have used with explanation and reason. Students have to be acquainted with forms of cooperative work between peer groups, with the application of the deductive approach, with preparation of project papers, with seminary instruction and discussion forums about special themes.
- The teacher has to observe the following peculiarities of grades 11 and 12 (as compared with mathematics learning of grades 9 and 10).
- deeper penetration into modern and general mathematical theories,
- higher level of abstraction and generalization,
- higher demands with regard to logical strictness in the treatment of subject matter and the exactness of mathematical language (including terminology and symbolism)

- closer relations to neighboring disciplines and ranges of application, especially to Physics, Technology and Agriculture.
- The time allotment for grades 11 and 12 is made for 33 weeks (165 periods). The remaining weeks have to be used for revision, systematization and evaluation.
- Units 1, 2, 3, 4, 5, 6 and 7 of Grades 11 and units 1, 2, 3, 4 and 5 of Grades 12 are common to both natural science and social science stream students, While units 7 and 8 of Grades 11 and units 6 and 7 of Grades 12 are to be offered only to natural science stream students and units 9 and 10 of Grades 11 and units 8 and 9 of Grades 12 are only for social science stream students.

Cycle Objectives

Objectives of Mathematics Learning in the Second Cycle of Secondary Education (Grades 11 and 12)

At the end of the second cycle of secondary education, students should be able to:

- apply the mathematical knowledge and capabilities gained to solve problems independently.
- develop mental abilities and high skills and competencies in calculations, especially, in the field of logical thinking, reasoning, proving, defining and use of mathematical language, terminologies and symbols correctly.
- develop an appreciation for the importance of mathematics as a field of study by learning its historical development, scope and its relationship with other disciplines.
- develop scientific outlook and personality characteristics such as working activities with algorithms, exactness, neatness, honesty and carefulness according to self prepared plans for solving problems in line with the needs of the society.

Allotment of Periods
for Units and Sub-units of Mathematics
Grades 11 and 12

Grade	Unit	Sub-unit	Number of Periods	
			Sub-unit	Total

11	**Unit 1: Further on Relations and Functions**	1.1 Revision on Relation and Inverse of a Relation
		    1.1.1 Inverse of a relation
		    1.1.2 Graphs of inverse relations
		1.2 Some Additional Types of Functions
		    1.2.1 Power Functions with their Graphs
		    1.2.2 Modulus Functions (Absolute Value Functions)
		    1.2.3 Signum Function
		    1.2.4 Greatest Integer Function
		1.3 Classification of Functions
		    1.3.1 One-to-one Functions
		    1.3.2 Onto Functions
		1.4 Composition of Functions
		1.5 Inverse Functions and their Graphs
			2
			
			4
			
			2
			
			3
			4
				15

	Unit 2: Rational Expressions and Rational Functions	2.1 Simplification of Rational Functions
		    2.1.1 Operations with rational expressions
		    2.1.2 Decomposition of rational expressions into partial fractions.
		2.2 Rational Equations and. …
		2.3 Rational Functions and their Graphs
		    2.3.1 Rational Functions
		    2.3.2 Graphs of Rational Functions
			4
			
			3
			5
				12

	Unit 3: Coordinate Geometry	3.1 Straight Lines
		    3.1.1 Angle between two lines on the coordinate plane
		    3.1.2 Distance between a point and a line on the coordinate plane
		3.2 Conic Sections
		    3.2.1 Cone and sections of a cone
		    3.2.2 Circles
		    3.2.3 Parabola
		    3.2.4 Ellipses
		    3.2.5 Hyperbolas
			3
			
			18
				21

Grade	Unit	Sub-unit	Number of Periods	
			Sub-unit	Total

11	**Unit 4: Mathematical Reasoning**	4.1 Logic
		  4.1.1 "Statements and Open Statements"
		  4.1.2 Fundamental Logical Connectives
		  4.1.3 Compound Statements
		  4.1.4 Properties and Laws of Logical Connectives
		  4.1.5 Contradiction and Tautology
		  4.1.6 Converse and Contra positive
		  4.1.7 Quantifiers
		4.2 Argument and Validity
		    - Rules of Inference
			13
			
			3
				16

	Unit 5: Statistics and Probability	5.1 Statistics
		  5.1.1 Types of data
		  5.1.2 Introduction to Grouped data
		  5.1.3 Measures of Location for Grouped Data
		  5.1.4 Measures of Dispersion
		5.2 Probability
		  5.2.1 Permutations and Combinations
		  5.2.2 Bionomial Theorem
		  5.2.3 Random Experiment and its outcomes
		  5.2.4 Events
		  5.2.5 Probability of an event
			14
			
			17
				31

	Unit 6: Matrices and Determinants	6.1 Matrices 6.2 Determinants and their properties 6.3 Inverse of a square matrix 6.4 Systems of equations with two or three variable 6.5 Cramer's Rule	4 6 4 5 3	22
	Unit 7: The set of Complex Numbers	7.1 The concept of Complex Numbers 7.2 Operations on Complex Numbers 7.3 Conjugate and Modulus of Complex Numbers 7.4 Simplification of Complex Numbers 7.5 Argand Diagram and Polar Representation of Complex Numbers	2 3 2 3 3	13

Grade	Unit	Sub-unit	Number of Periods	
			Sub-unit	Total
	Unit 8: Vectors and Trans	8.1 Vectors and Scalars 8.2 Representation of Vectors 8.3 Scalar (inner or dot) Product 8.4 Application of Vectors 8.5 Transformations of the plane	3 1 3 5 8	20
	Unit 9: Further on Trigonometric Functions	9.1 The Functions sec x, cosec x, and cot x 9.2 Inverse of Trigonometric Functions 9.3 Graphs of Some Trigonometric Functions 9.4 Application of Trigonometric Function	5 4 5 6	20
	Unit 10: Introduction to Linear Programming	10.1 Revision on Linear Graphs 10.2 Graphical solution of system of Linear inequalities 10.3 Maximum and Minimum Values 10.4 Real life linear programming problems	2 2 5 6	15

	Unit 11: Mathematical Application in Business	11.1 Basic Mathematical Concepts in Business
		■ Ratio
		■ Rate
		■ Proportion
		■ Percentage
		11.2 Compound Interest and Depreciation
		    11.2.1 Compound Interest
		    11.2.2 Depreciation
		11.3 Saving, Investing and Borrowing Money
		    11.3.1 Saving Money
		    11.3.2 Investment
		    11.3.3 Borrowing Money
		11.4 Taxation (4 periods)
			3
			
			4
			
			7
			
			4
				18

Grade	Unit	Sub-unit	Number of Periods	
			Sub-unit	Total
12	**Unit 1: Sequence and Series**	1.1 Sequences (sequences of numbers) 1.2 Arithmetic sequence and Geometric sequence. 1.3 The sigma notation (Σ) and partial sums. 1.4 The notion of "Infinite series" 1.5 Application of Sequence and series	3 3 6 4 2	18
	Unit 2: Introduction to Limits and Continuity	2.1 Limits of sequence of numbers 2.2 Limits of functions 2.3 Continuity of a function 2.4 Exercises on the application of limits 2.5 Miscellaneous exercises	12 6 5 3 2	28

	Unit 3: Introduction to Differential Calculus	3.1 Introduction to Derivatives
		  • understanding rates of change
		  • Graphical definition of derivative
		  • Formal definition (Differentiability at a point)
		  • Differentiability over an interval
		3.2 Derivatives of different functions.
		  • Differentiation of power, simple trigonometric, exponential and logarithmic functions.
		3.3 Derivatives of combinations and compositions of functions
		3.4 Miscellaneous exercise
			10
			
			3
			
			12
			2
				27

	Unit 4: Applications of Derivatives	4.1 Extreme values of functions 4.2 Minimization and maximization problems 4.3 Rate of change	13 6 6	25

	Unit 5: Introduction to Integral Calculus	5.1 Integration as inverse process of differentiation
		  • Integral of:
		    - Constant
		    - Power
		    - Trigonometric
		    - Exponential and logarithmic functions
		5.2 Techniques of integration
		  • Elementary substitution
		  • Partial fractions
		  • Integration by parts
		5.3 Definite integrals, area and fundamental theorem of calculus
			7
			
			9
			
			8
				30

Grade	Unit	Sub-unit	Number of Periods	
			Sub-unit	*Total*
		5.4 Applications of integral calculus	6	
	Unit 6: Three Dimensional Geometry and Vectors in Space	**(Topics for Natural Science Stream only)** 6.1 Coordinate axes and coordinate planes in space 6.2 Coordinates of a point in space 6.3 Distance between two points in space 6.4 Mid - point of a segment in space 6.5 Equation of sphere 6.6 Vectors in space	 2 2 2 1 2 8	17
	Unit 7: Mathematical Proofs	7.1 Revision on logic 7.2 Different types of proofs 7.3 Principles and applications of mathematical induction 7.4 General exercises	5 4 4 2	15
	Unit 8: Further on Statics	**(Topics for Social Science Stream only)** 8.1 Sampling techniques 8.2 Representation of data 8.3 Construction of graphs and interpretation 8.4 Measures of central tendency and variation of a set of data, including grouped data. (Mean, Median, Mode, Range, Inter quartile rang and Standard deviation from the data itself or from given totals) 8.5 Analysis of frequency distributions with equal means but different variances (coefficients of variation). 8.6 Use of cumulative frequency graph to estimate median value, quartile and inter quartile range of a set of data.	 3 2 6 5 2 4	22
	Unit 9: Mathematical Applications for Business and Consumers	9.1 Applications to purchasing 9.2 Percent increase and percent decrease 9.3 Real estate expenses 9.4 Wages	3 4 4 4	15