

National Curriculum of Pakistan  
2025

# FUNCTIONAL MATHEMATICS

Grades 9-10



**NATIONAL CURRICULUM COUNCIL WING**  
MINISTRY OF FEDERAL EDUCATION AND  
PROFESSIONAL TRAINING, ISLAMABAD  
GOVERNMENT OF PAKISTAN



بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِیْمِ

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## Preface

The curriculum of *Functional Mathematics* for grades IX–X is designed for students pursuing technical education to meet the professional and labor market needs of the country. It emphasizes arithmetic skills relevant to both personal and vocational business opportunities and introduces key areas of financial and business mathematics, providing a strong foundation for further studies in business management and digital literacy. The curriculum also highlights practical geometry, enabling students to construct plane figures effectively, and stresses the importance of graphics to help them visualize and interpret mathematical expressions accurately.

The curriculum equips students with essential mathematical knowledge, including numbers and algebra, geometry, basic statistics and probability, alongside business-related concepts such as partnerships, foreign exchange, leasing and financing, budgeting, Islamic banking, and insurance. It enhances problem-solving skills for real-life issues such as computing income and utility bills and strengthens their understanding of Zakat, Ushr and various taxes.

Teachers are expected to facilitate investigative tasks, foster independent thinking, and integrate AI tools and digital materials to align students with international standards. Authors should develop clear, practical resources linked to real-life applications. Teachers must engage students through problem-solving and technology-based learning. Assessment experts should emphasize mental mathematics and real-life-based questions aligned with the learning outcomes mentioned in the curriculum to evaluate students' ability to apply mathematical skills in technical and vocational contexts.

Functional Mathematics helps students apply math skills to everyday life, such as managing budgets, calculating utility bills, and understanding savings and insurance. For example, students learn to compute monthly expenses, calculate interest on savings, and convert foreign exchange rates while traveling or doing business. It also teaches practical skills like handling business partnerships and analyzing data using basic statistics, helping them make informed financial and business decisions.

**Dr. Tabassum Naz**  
Director (NCC)



## Progression Grid

### Domain A: NUMBERS AND ALGEBRA

The number system is a method of representing numbers in mathematics. Students work with various types of numbers to solve mathematical formulae and calculations, process data, and handle complex topics in all branches of mathematics. Algebra is one of the oldest branches of mathematics which involves the study of mathematical symbols and the rules for manipulating these symbols in formulas, serving as a unifying thread across almost all areas of mathematics. Algebra encompasses everything from solving elementary equations to exploring abstract mathematical concepts, with numerous algebraic equations, formulae, and identities.

**Standard 1:** Developing mathematical reasoning and problem-solving skills by applying concepts of financial mathematics, algebra, real numbers, matrices, and sequences to real-world, using analytical thinking to interpret data, model situations, and make informed decisions in financial, economic, and scientific contexts.

Grade 9	Grade 10
<p><b>Benchmark I:</b> Students will analyze and apply mathematical principles in financial decision-making, including currency conversion, budgeting, taxation, zakat, inheritance, and Islamic finance, to solve real-world economic and social challenges.</p> <p><b>Benchmark II:</b> Students will demonstrate proficiency in algebraic reasoning by solving algebraic equations, manipulating expressions, and using matrices to model and interpret mathematical and real-world problems.</p> <p><b>Benchmark III:</b> Students will evaluate and predict numerical patterns, trends, and relationships through sequences and inequalities by applying these concepts in fields such as engineering, economics, and data science.</p>	
<p><b>Student Learning Outcomes</b></p>	
<p><b>Business Mathematics</b>            [SLO: M-09-A-01]: Solve real-life currency exchange problems by converting Pakistani currency to and from well-known international currencies, both manually and through appropriate apps.  <b>Cognitive Level: Understanding/Application</b>            [SLO: M-09-A-02]: Calculate mentally and use appropriate formulae for finding cost price, selling price, profit, loss, discount and commission.</p>	<p><b>Financial Mathematics</b>            [SLO: M-10-A-01]: Solve problems related to leasing/financing of motor vehicles under different conditions.  <b>Cognitive Level: Understanding/Application</b>            [SLO: M-10-A-02]: Calculate mentally and use appropriate formulae for finding profit/markup, principal amount, profit/markup rate and period.</p>

<p><b>Cognitive Level: Knowledge/Understanding</b> [SLO: M-09-A-03]: Apply the concept of profit, loss, discount and commission to real world problems.</p> <p><b>Cognitive Level: Application</b></p>	<p><b>Cognitive Level: Knowledge/Understanding</b> [SLO: M-10-A-03]: Solve simple real-life problems regarding profit/markup, life insurance and motor vehicle insurance.</p> <p><b>Cognitive Level: Application</b></p>
<p><b>Budgeting</b> [SLO: M-09-A-04]: Apply ratios and proportions to allocate income across different budget categories.</p> <p><b>Cognitive Level: Understanding</b> [SLO: M-09-A-05]: Solve real-world problems involving unit rates, such as cost per item or hourly wages.</p> <p><b>Cognitive Level: Application</b> [SLO: M-09-A-06]: Use algebraic expressions to model financial situations, such as setting up equations for income and expenditure balance.</p> <p><b>Cognitive Level: Application</b> [SLO: M-09-A-07]: Use percent increase and decrease to track changes in income or expenses over time.</p> <p><b>Cognitive Level: Understanding</b> [SLO: M-09-A-08]: Estimate future expenses and income using simple linear projections.</p> <p><b>Cognitive Level: Understanding</b> [SLO: M-09-A-09]: Apply logical reasoning to adjust a budget when expenses exceed income.</p> <p><b>Cognitive Level: Application</b></p>	<p><b>Consumer Mathematics</b> [SLO: M-10-A-04]: Apply budgeting techniques (e.g., 50/30/20 rule, zero based budgeting) to allocate money wisely and use simple mathematical calculations to balance income and expenses.</p> <p><b>Cognitive Level: Understanding/Application</b> [SLO: M-10-A-05]: Calculate personal income (weekly, monthly, and annually) of a worker or a salaried person.</p> <p><b>Cognitive Level: Knowledge/Understanding</b> [SLO: M-10-A-06]: Calculate net income taking into account after deductions (income tax, etc.).</p> <p><b>Cognitive Level: Understanding</b> [SLO: M-10-A-07]: Calculate mentally and use appropriate formulae for finding the amount of general sales tax, property tax, income tax and excise duty.</p> <p><b>Cognitive Level: Knowledge/Understanding</b> [SLO: M-10-A-08]: Calculate the amount of the utility bills (such as electricity and gas bills).</p> <p><b>Cognitive Level: Understanding</b></p>
<p><b>Zakat, Ushr and Inheritance</b> [SLO: M-09-A-10]: Calculate mentally and use appropriate formula for finding Zakat, Ushr and inheritance.</p> <p><b>Cognitive Level: Knowledge/Understanding</b> [SLO: M-09-A-11]: Solve real world word problems involving Zakat, Ushr and inheritance.</p>	<p><b>Islamic Finance</b> [SLO: M-10-A-09]: Calculate and compare percentage-based returns in conventional interest and Islamic profit-sharing models.</p> <p><b>Cognitive Level: Understanding/Application</b> [SLO: M-10-A-10]: Apply ratios and proportions to determine profit distribution</p>

**Cognitive Level: Application**

in Islamic finance contracts such as Mudarabah and Musharakah.

**Cognitive Level:**

**Understanding/Application**

[SLO: M-10-A-11]: Solve algebraic equations to find unknown values in Islamic banking and investment models.

**Cognitive Level:**

**Understanding/Application**

[SLO: M-10-A-12]: Analyze graphical representations of interest growth versus profit-sharing models over time (manually and by using 'Graphical Calculator').

**Cognitive Level: Application**

[SLO: M-10-A-13]: Apply the concept of time value of money in an Islamic financial context without using interest-based calculations.

**Cognitive Level:**

**Understanding/Application**

[SLO: M-10-A-14]: Apply exponential growth and decay formulas to compare savings in Islamic finance and conventional interest-based savings accounts.

**Cognitive Level:**

**Understanding/Application**

[SLO: M-10-A-15]: Interpret real-world financial data and case studies using mathematical calculations related to Islamic banking.

**Cognitive Level:**

**Understanding/Application**

### **Real Numbers**

[SLO: M-09-A-12]: Describe the set of real numbers as a combination of rational and irrational numbers.

**Cognitive Level: Knowledge**

[SLO: M-09-A-13]: Apply the properties of equality and inequality of real numbers.

**Cognitive Level: Knowledge/Understanding**

### **Matrices and Determinants**

[SLO: M-10-A-16]: Display information in the form of matrix of order 2.

**Cognitive Level: Knowledge**

[SLO: M-10-A-17]: Solve situations involving sum, difference, and product of two matrices.

**Cognitive Level: Understanding**

[SLO: M-10-A-18]: Calculate the product of the scalar quantity and a matrix.

<p>[SLO: M-09-A-14]: Differentiate between radical form and exponential form of an expression.</p> <p><b>Cognitive Level: Understanding</b></p> <p>[SLO: M-09-A-15]: Transform an expression given in radical form to an exponential form and vice versa.</p> <p><b>Cognitive Level: Understanding</b></p> <p>[SLO: M-09-A-16]: Apply laws of indices to simplify radical expressions.</p> <p><b>Cognitive Level: Understanding</b></p> <p>[SLO: M-09-A-17]: Express a number in scientific notation and vice versa.</p> <p><b>Cognitive Level: Knowledge</b></p> <p>[SLO: M-09-A-18]: Apply concepts of real numbers (such as inventory stock taking, temperature, banking, sources of income and expenditure).</p> <p><b>Cognitive Level: Application</b></p>	<p><b>Cognitive Level: Knowledge</b></p> <p>[SLO: M-10-A-19]: Evaluate the determinant and inverse of a matrix of order <math>2 \times 2</math>.</p> <p><b>Cognitive Level: Understanding</b></p> <p>[SLO: M-10-A-20]: Solve the simultaneous linear equations in two variables using matrix inversion method and Cramer's rule.</p> <p><b>Cognitive Level: Understanding</b></p> <p>[SLO: M-10-A-21]: Apply concepts of matrices to real world problems (such as engineering, economics, computer graphics, and finance).</p> <p><b>Cognitive Level: Application</b></p>
<p><b>Factorization and Algebraic Manipulation</b></p> <p>[SLO: M-09-A-19]: Identify common factors of polynomials.</p> <p><b>Cognitive Level: Knowledge</b></p> <p>[SLO: M-09-A-20]: Factorize quadratic and biquadratic algebraic expressions.</p> <p style="padding-left: 20px;"><i>Type – I : <math>x^2 + px + q, ax^2 + bx + c</math></i></p> <p style="padding-left: 20px;"><i>Type – II : <math>a^4 + a^2b^2 + b^4, a^4 + 4b^4</math></i></p> <p><b>Cognitive Level: Understanding</b></p> <p>[SLO: M-09-A-21]: Find highest common factor and least common multiple of algebraic expressions by factorization and to know relation of LCM and HCF.</p> <p><b>Cognitive Level: Knowledge/Understanding</b></p> <p>[SLO: M-09-A-22]: Find square root of algebraic expression by factorization.</p> <p><b>Cognitive Level: Knowledge/Understanding</b></p> <p>[SLO: M-09-A-23]: Apply the concepts of factorization of algebraic expressions to real world problems (such as engineering, business and finance.)</p> <p><b>Cognitive Level: Application</b></p>	<p><b>Algebraic Fractions</b></p> <p>[SLO: M-10-A-22]: Factorize and simplify rational expressions (limited to numerators and denominators that are monomials, binomials, or trinomials).</p> <p><b>Cognitive Level: Understanding</b></p> <p>[SLO: M-10-A-23]: Apply the concept of rational equations (limited to numerators and denominators that are monomials, binomials, or trinomials) to real world problems (such as the amount of work a person can do in certain amount of time).</p> <p><b>Cognitive Level: Application</b></p>

### Linear Equations and Inequalities in One Variable

[SLO: M-09-A-24]: Solve linear equations in one variable manually and by using appropriate apps like ‘Equation Solver’.

**Cognitive Level: Understanding**

[SLO: M-09-A-25]: Solve linear inequalities in one variable and represent the solution set on a real line.

**Cognitive Level: Understanding**

[SLO: M-09-A-26]: Apply the concept of linear equations and linear inequalities to real world problems (such as cost and revenue analysis, construction and architecture, temperature conversion, predicting population growth etc.).

**Cognitive Level: Application**

### Linear Equations and Inequalities in Two Variables

[SLO: M-10-A-24]: Solve two linear equations in two unknowns simultaneously (manually and by using appropriate apps like ‘Equation Solver and Graphing Calculator’).

**Cognitive Level: Understanding**

[SLO: M-10-A-25]: Solve two linear inequalities in two unknowns simultaneously.

**Cognitive Level: Understanding**

[SLO: M-10-A-26]: Interpret and identify regions in plane bounded by two linear inequalities in two unknowns manually and by using appropriate apps like ‘Graphing Calculator’.

**Cognitive Level: Understanding**

### Quadratic Equations

[SLO: M-10-A-27]: Solve quadratic equations of the form  $ax^2 + bx + c = 0$ , ( $a \neq 0$ ) by factorization, completing square method and quadratic formula (only real solutions).

**Cognitive Level: Understanding**

[SLO: M-10-A-28]: Draw the graphs of  $y = ax^2 + bx + c$ , ( $a \neq 0$ ) manually and by using graphical calculator.

**Cognitive Level: Knowledge**

[SLO: M-10-A-29]: Apply the concept of quadratic equations to real world problems.

**Cognitive Level: Application**

### Sequences and Series

[SLO: M-10-A-30]: Identify a given sequence as arithmetic or geometric.

**Cognitive Level: Knowledge**

[SLO: M-10-A-31]: Find specified term in a given arithmetic or geometric sequence.

**Cognitive Level: Understanding**

[SLO: M-10-A-32]: Apply the concept of arithmetic and geometric sequences to predict patterns and trends.

**Cognitive Level: Application**

## Domain B: GEOMETRY

Geometry is a highly practical branch of mathematics that deals with the shapes, sizes, and properties of figures. The fundamental elements of geometry include points, lines, angles, surfaces, and solids. It helps develop reasoning and problem-solving skills by applying the properties of lines, triangles, quadrilaterals, and circles. Concepts such as length, perimeter, area, circumference, surface area, and volume are used to solve real-world problems.

**Standard 2:** Developing analytical thinking by applying concepts of coordinate geometry, graph theory, trigonometry, and practical geometry to solve mathematical and real-world problems, using geometric and algebraic methods to interpret, model, and construct figures, shapes, and relationships in two and three dimensions.

Grade 9	Grade 10
<p><b>Benchmark I:</b> Students will analyze and apply coordinate geometry and trigonometry to solve complex real-world problems, including applications in engineering, navigation, and digital networks.</p> <p><b>Benchmark II:</b> Students will demonstrate problem-solving skills by constructing geometric figures, analyzing relationships between shapes, and applying geometric principles in designing and modeling real-life structures.</p>	
Student Learning Outcomes	
<p><b>Coordinate Geometry</b></p> <p>[SLO: M-09-B-01]: Derive and apply distance formula by locating the position of two points in coordinate plane. <b>Cognitive Level: Understanding</b></p> <p>[SLO: M-09-B-02]: Calculate the midpoint of a line segment. <b>Cognitive Level: Knowledge</b></p> <p>[SLO: M-09-B-03]: Find the gradient of a straight line when coordinates of two points are given. <b>Cognitive Level: Knowledge</b></p> <p>[SLO: M-09-B-04]: Find the equation of a straight line in the slope intercept form, point slope form and two-point form. <b>Cognitive Level: Understanding</b></p> <p>[SLO: M-09-B-05]: Find the gradient of parallel and perpendicular lines. <b>Cognitive Level: Understanding</b></p> <p>[SLO: M-09-B-06]: Find the angle between two coplanar intersecting straight lines. <b>Cognitive Level: Knowledge/Understanding</b></p>	<p><b>Graph Theory (Digital Literacy)</b></p> <p>[SLO: M-10-B-01]: Define fundamental terms of graph theory including vertices (nodes), edges, degree, paths, and cycles. <b>Cognitive Level: Knowledge</b></p> <p>[SLO: M-10-B-02]: Identify and differentiate between types of graphs such as simple, directed, undirected, weighted, and connected graphs. <b>Cognitive Level: Knowledge/Understanding</b></p> <p>[SLO: M-10-B-03]: Represent graphs using adjacency matrices and adjacency lists. <b>Cognitive Level: Understanding</b></p> <p>[SLO: M-10-B-04]: Describe real-world applications of graph theory, such as transportation networks, social networks, and computer networks. <b>Cognitive Level: Application</b></p>

Grade 9	Grade 10
<p>[SLO: M-09-B-07]: Calculate angles of the triangle when the slopes of the sides are given.  <b>Cognitive Level: Understanding</b></p> <p>[SLO: M-09-B-08]: Apply concepts from coordinate geometry to real world problems (such as, aviation and navigation, landscaping, map reading, longitude and latitude).  <b>Cognitive Level: Application</b></p>	
<p><b>Area and Volume of Similar Figures</b></p> <p>[SLO: M-09-B-09]: Convert standard units of area (<math>m^2</math>, <math>cm^2</math>, <math>mm^2</math> and vice versa) and volume (<math>m^3</math>, <math>cm^3</math>, <math>mm^3</math> and vice versa) manually and by using appropriate Apps.  <b>Cognitive Level: Knowledge</b></p> <p>[SLO: M-09-B-10]: Identify similarity of polygons.  <b>Cognitive Level: Knowledge</b></p> <p>[SLO: M-09-B-11]: Find the relation between area of similar figures.  <b>Cognitive Level: Understanding</b></p> <p>[SLO: M-09-B-12]: Find the relation between volume of similar solids.  <b>Cognitive Level: Understanding</b></p> <p>[SLO: M-09-B-13]: Solve problems using the relation between areas of similar figures and volume of different solids (cube, cuboid, cone, cylinder and sphere).  <b>Cognitive Level: Application</b></p>	
<p><b>Construction of Triangle</b></p> <p>[SLO: M-09-B-14]: Construct a triangle using ruler, protractor and pair of compasses.  Case-I: Given two sides and the included angle.  Case-II: Given one side and two of the angles.  Case-III: Given two of its sides and the angle opposite to one of them (with all the three possibilities).  <b>Cognitive Level: Understanding</b></p> <p>[SLO: M-09-B-15]: Draw angle bisectors, perpendicular bisectors, medians, altitudes of a given triangle using ruler, protractor and pair of compasses and verify their concurrency.</p>	<p><b>Practical Geometry of Circles</b></p> <p>[SLO: M-10-B-05]: Locate the Centre of a given circle.  <b>Cognitive Level: Understanding</b></p> <p>[SLO: M-10-B-06]: Draw a circle passing through three given non collinear points.  <b>Cognitive Level: Understanding</b></p> <p>[SLO: M-10-B-07]: Complete the circle: by finding the Centre, without finding the Centre, when a part of its circumference is given.  <b>Cognitive Level: Understanding</b></p>

Grade 9	Grade 10
<p><b>Cognitive Level: Understanding</b></p>	<p>[SLO: M-10-B-08]: Draw a tangent to a given circle from a point P when P lies on the Circumference, outside the circle.  <b>Cognitive Level: Understanding</b></p> <p>[SLO: M-10-B-09]: Draw two tangents to a circle meeting each other at a given angle.  <b>Cognitive Level: Understanding</b></p> <p>[SLO: M-10-B-10]: Apply concepts of practical geometry of a circle to real life world problems (such as athletic tracks, recreational parks, Ferris wheels, mechanical models)  <b>Cognitive Level: Application</b></p>
<p><b>Trigonometry</b>  [SLO: M-09-B-16]: Identify angles in standard position, expressed in degrees.  <b>Cognitive Level: Knowledge</b></p> <p>[SLO: M-09-B-17]: Find trigonometric ratios of acute angle in a right triangle.  <b>Cognitive Level: Knowledge</b></p> <p>[SLO: M-09-B-18]: Apply Pythagoras' theorem and trigonometric ratios of acute angles to find unknown sides and angles of a right-angled triangle.  <b>Cognitive Level: Understanding</b></p> <p>[SLO: M-09-B-19]: Solve real life trigonometric problems in two dimensions involving angles of elevation and depression.  <b>Cognitive Level: Application</b></p>	<p><b>Applications of Trigonometry</b>  [SLO: M-10-B-11]: Solve triangles using the laws of sine and cosine.  <b>Cognitive Level: Understanding</b></p> <p>[SLO: M-10-B-12]: Find area of triangles by using formulae.  <b>Cognitive Level: Knowledge/Understanding</b></p> <p>[SLO: M-10-B-13]: Apply concepts of trigonometry to real life world problems (such as video games, flight engineering, navigation, sound waves).  <b>Cognitive Level: Application</b></p>

### Rationale

Mathematics is the study of order, relationships, and patterns, originating from counting and measuring and evolving into a sophisticated language that describes much of the modern world. Statistics focuses on collecting, analyzing, modeling, and interpreting data to investigate real-world phenomena and solve problems in context. Together, mathematics and statistics provide a powerful, logical, concise, and precise framework for thinking and communication, particularly in analyzing uncertainty and variation. This domain forms a strong foundation for further studies in disciplines where mathematics and statistics are essential, including health and social sciences. The curriculum is designed for students whose future pathways may involve mathematics and statistics and their applications across various fields at the tertiary level.



### **Domain C: INFORMATION HANDLING**

Information Handling equips students with the skills to collect, analyze, and interpret data, enabling them to investigate real-world phenomena and make informed decisions. By recognizing patterns and relationships, students develop logical reasoning and problem-solving abilities essential for understanding uncertainty and variation. This domain forms a strong foundation for future studies and practical applications across various fields, preparing learners to navigate an increasingly data-driven world.

**Standard 3:** Applying statistics and probability to analyze data, interpret results and solve real-life problems in decision-making across various fields.

Grade 9	Grade 10
<p><b>Benchmark I:</b> Students will construct and interpret statistical representations, analyze measures of central tendency and dispersion, and apply probability laws to solve real-world problems.</p>	
<p><b>Student Learning Outcomes</b></p>	
<p><b>Basic Statistics and Probability</b>            [SLO: M-09-C-01]: Construct a grouped frequency table, histogram (with equal and unequal class intervals) and frequency polygon (manually and by using appropriate apps like ‘Histogram Maker’ etc.)  <b>Cognitive Level: Understanding/Application</b>            [SLO: M-09-C-02]: Calculate the mean (by direct method), median and mode of a grouped frequency distribution (manually and using appropriate apps like Microsoft Excel, Google Sheets, LibreOffice Calc etc.).  <b>Cognitive Level: Understanding</b>            [SLO: M-09-C-03]: Solve real life situations involving mean, median, and mode for given data (such as allocation of funds in different projects, forecasting future demographics, marketing, forecasting government budgets).  <b>Cognitive Level: Application</b>            [SLO: M-09-C-04]: Calculate the probability of a single event and the probability of complementary event.  <b>Cognitive Level: Understanding</b>            [SLO: M-09-C-05]: Calculate relative and expected frequencies as an estimate of probability.  <b>Cognitive Level: Understanding</b>            [SLO: M-09-C-06]: Solve real life problems involving probability, relative and expected frequencies.  <b>Cognitive Level: Application</b></p>	<p><b>Basic Statistics and Probability</b>            [SLO:M-10-C-01]: Construct cumulative frequency table, cumulative frequency polygon and cumulative frequency curve (manually and by using appropriate apps like ‘Graphing Calculator’ etc.)  <b>Cognitive Level: Understanding/Application</b>            [SLO: M-10-C-02]: Interpret the median, quartiles, and inter quartile range from cumulative frequency curve.  <b>Cognitive Level: Understanding</b>            [SLO: M-10-C-03]: Calculate the range, standard deviation and variance for grouped data (manually and using appropriate apps like Microsoft Excel, Google Sheets, LibreOffice Calc etc.).  <b>Cognitive Level: Understanding</b>            [SLO: M-10-C-04]: Use the mean and standard deviation to compare two sets of data.  <b>Cognitive Level: Understanding</b>            [SLO: M-10-C-05]: Apply concepts from measures of dispersion to solve real life situations (such as determining the consistency of data, checking variability in forecasting, manufacturing, finance, economics).  <b>Cognitive Level: Application</b>            [SLO: M-10-C-06]: Calculate the probability of combined events using sample space diagrams, possibility diagrams and tree diagrams, where appropriate.  <b>Cognitive Level: Understanding</b>            [SLO: M-10-C-07]: Apply addition law of probability to solve problems involving mutually exclusive events (such as left and right hand turns, tossing a coin, even and odd numbers on a die, winning and losing a game).  <b>Cognitive Level: Application</b></p>



**Note:**

1. Cognitive levels (Knowledge, Understanding, Application) are mentioned against each SLO.
2. Proportionate / equitable representation of the content areas may be ensured.
3. Suggested percentage of cognitive levels is 20%, 50%, and 30% for knowledge, understanding, and application, respectively with  $\pm 5\%$  variation.
4. Use of digital tools/apps to solve mathematical problems may be a part of regular Teaching / learning practices where appropriate. However, such practices will not be the part of final assessment.

## Teaching Learning Strategies

Functional Mathematics is a fundamental subject that builds logical reasoning, analytical thinking, and problem-solving skills. In the National Curriculum of Pakistan (NCP), Mathematics for grades 9-10 is designed to equip students with practical and theoretical knowledge applicable to real-world scenarios, particularly in technical and vocational fields.

Effective teaching in mathematics requires a focus on:

- **Conceptual Understanding:** Ensuring students grasp mathematical principles, rather than just memorizing formulas.
- **Application of Skills:** Encouraging problem-solving, critical thinking, and mathematical reasoning in practical contexts.
- **Student-Centered Learning:** Using engaging, interactive, and inquiry-based methods to develop a strong mathematical foundation.
- **Technology Integration:** Leveraging digital tools and simulations to enhance visualization and understanding of mathematical concepts.

Teachers must adopt flexible instructional strategies that cater to diverse learning needs, ensuring that students can relate mathematical concepts to their technical education and future careers.

### Instructional Techniques

Engaging students effectively and strengthening their conceptual understanding in mathematics requires the integration of diverse instructional techniques that cater to their learning needs and real-world applications.

1. **Problem-Based Learning (PBL):** Encourages students to engage with real-world problems, fostering analytical and critical thinking skills.
2. **Collaborative Learning:** Promotes teamwork and communication by engaging students in group activities and discussions.
3. **Inquiry-Based Learning:** Encourages students to explore mathematical concepts through questioning, investigation, and discovery.
4. **Differentiated Instruction:** Adapts teaching methods to cater to students' diverse learning needs, ensuring personalized learning experiences.
5. **Technology-Enhanced Learning:** Leverages digital tools, simulations, and interactive resources to improve conceptual understanding and application.

## Core Teaching Processes and Areas

Teaching Process	Teaching Areas
<p style="text-align: center;"><b>Assessment and Feedback</b></p>	<ul style="list-style-type: none"> <li>• Checking for understanding and providing timely feedback.</li> <li>• Encouraging self-directed learning.</li> <li>• Assigning meaningful tasks that reinforce concepts.</li> </ul>
<p style="text-align: center;"><b>Positive Classroom Culture</b></p>	<ul style="list-style-type: none"> <li>• Establishing interaction and rapport.</li> <li>• Maintaining a positive and disciplined learning environment.</li> <li>• Setting clear expectations and routines.</li> <li>• Building trust and encouraging student empowerment.</li> </ul>
<p style="text-align: center;"><b>Activating Prior Knowledge</b></p>	<ul style="list-style-type: none"> <li>• Arousing interest through relatable examples.</li> <li>• Engaging learners with interactive discussions.</li> <li>• Adapting instruction to student needs.</li> <li>• Providing clear explanations and maintaining instructional momentum.</li> <li>• Promoting collaborative learning.</li> </ul>
<p style="text-align: center;"><b>Using Questions to Deepen Learning</b></p>	<ul style="list-style-type: none"> <li>• Encouraging higher-order thinking.</li> <li>• Guiding students in making connections between concepts.</li> <li>• Facilitating exploration and reasoning.</li> </ul>



## Assessment

Examinations are structured methods of evaluating students' knowledge, skills, and problem-solving abilities. They provide a benchmark for measuring academic progress and ensuring students meet the required learning standards. In the technical education stream, examinations may assess both theoretical understanding and practical applications of mathematical concepts. Assessment is an integral part of examinations, helping to identify strengths and areas for improvement, thereby guiding instructional strategies to enhance student learning outcomes (Black & Wiliam, 2018)<sup>1</sup>.

### **Formative Assessment (Assessment for Learning)**

Formative assessment involves continuous evaluation during lessons through quizzes, interactive problem-solving tasks, and classroom discussions. This approach allows teachers to provide immediate feedback and adjust their instruction accordingly. For example, a teacher may use diagnostic questions to gauge students' understanding of algebraic expressions and modify lesson plans based on their responses. Research has shown that formative assessment can significantly enhance student learning by addressing misconceptions promptly and fostering a deeper understanding of mathematical concepts (Heritage, 2021)<sup>2</sup>.

Effective formative assessment should:

- Be continuous and embedded within daily instruction.
- Focus on students' conceptual understanding and problem-solving skills.
- Encourage reasoning, communication, and mathematical modeling.
- Help students develop independent learning strategies.

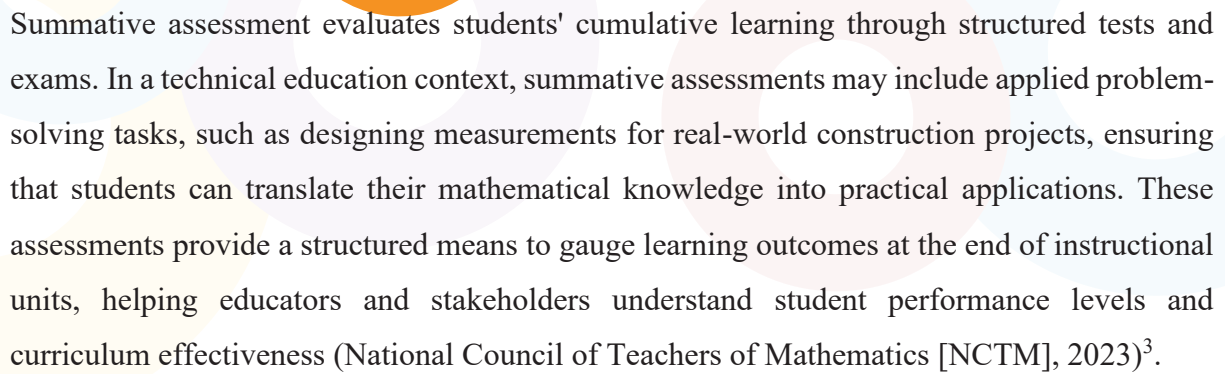
By identifying learning gaps early, formative assessment enables teachers to adjust instruction accordingly and empowers students to reflect on their learning process, taking ownership of their progress.

### **Summative Assessment (Assessment of Learning)**

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<sup>1</sup> Black, P., & Wiliam, D. (2018). *Assessment and classroom learning: Principles, policy & practice*. Routledge.

<sup>2</sup> Heritage, M. (2021). *Formative assessment in practice: A process of inquiry and action*. Harvard Education Press.



Summative assessment evaluates students' cumulative learning through structured tests and exams. In a technical education context, summative assessments may include applied problem-solving tasks, such as designing measurements for real-world construction projects, ensuring that students can translate their mathematical knowledge into practical applications. These assessments provide a structured means to gauge learning outcomes at the end of instructional units, helping educators and stakeholders understand student performance levels and curriculum effectiveness (National Council of Teachers of Mathematics [NCTM], 2023)<sup>3</sup>.

Summative assessments measure:

- Mastery of syllabus objectives.
- Application of mathematical concepts and skills.
- Problem-solving proficiency within real-world contexts.

### **Use of Technology and AI in Mathematics Education**

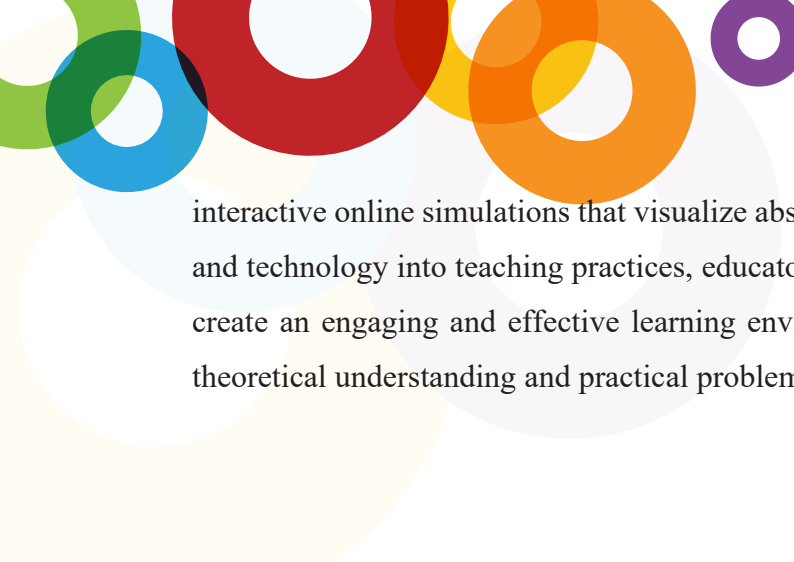
Technology and Artificial Intelligence (AI) are transforming mathematics education by making learning more interactive, personalized, and efficient. Digital tools such as simulations and online assessments help students visualize complex concepts and receive immediate feedback. AI-powered platforms adapt to individual learning needs, offering tailored exercises that challenge students at the appropriate level. Virtual tutors and chatbot assist in problem-solving, while AI-driven analytics help teachers identify areas where students need extra support. For instance, AI tools can generate multiple explanations for math concepts and formulae aimed at different audiences or levels of expertise, thereby enhancing personalized learning experiences (NCTM, 2023)<sup>4</sup>.

Effective use of digital tools includes adaptive learning platforms that modify question difficulty based on student performance, AI-generated assessments with instant feedback, and

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<sup>3</sup> National Council of Teachers of Mathematics (NCTM). (2023). *The effective and appropriate use of large-scale assessments in mathematics education to guide systemic improvement and equitable student learning*. Retrieved from <https://www.nctm.org/Standards-and-Positions/Position-Statements/The-Effective-and-Appropriate-Use-of-Large-Scale-Assessments-in-Mathematics-Education/>

<sup>4</sup> National Council of Teachers of Mathematics (NCTM). (2023). *Artificial intelligence and mathematics teaching*. Retrieved from <https://www.nctm.org/standards-and-positions/Position-Statements/Artificial-Intelligence-and-Mathematics-Teaching/>



interactive online simulations that visualize abstract mathematical concepts. By integrating AI and technology into teaching practices, educators in Pakistan's technical education stream can create an engaging and effective learning environment, ensuring that students develop both theoretical understanding and practical problem-solving skills.

## Weightage Percentage of the Content

Domain	Content Domain / Area	Weightage Percentage	
		Grade 9	Grade 10
A	Numbers and Algebra	51%	60%
B	Geometry	37%	25%
C	Information Handling	12%	15%
Total		100%	100%

## Suggested Weightage Percentage of the Cognitive Level Grade 9 and 10 for Assessment

Cognitive Level	Weightage Percentage (With variation $\pm 5\%$ )
Knowledge	20%
Understanding	50%
Application	30%
Total	100%

## Teaching and Learning Resources

In most Pakistani schools, the government-prescribed textbook is the primary teaching and learning tool. Although many other resources are available, accessible, and affordable, teachers rarely use those to support learning. Beyond textbooks, teaching and learning resources also include teacher manuals and electronic materials.

### I. The Textbook

Revamping the education system involves multiple stakeholders. Schools must play their role, parents must contribute, and teachers must take on a significant responsibility in fostering education. Print materials, particularly textbooks, play a crucial role in delivering quality education at all levels.

While various factors contribute to a child's overall learning experience, the textbook remains an essential reservoir of knowledge. Textbook writers have a vital role in shaping young minds through their work.

An effective textbook should:

- Have well-planned content and presentation,
- Be written by qualified and competent subject experts, and
- Be attractive and engaging to stimulate the interest of both teachers and students.

## Suggested Guidelines for Authors

Textbooks at lower levels tend to include more learning features than those at higher levels. However, when writing a textbook, the following aspects should be considered:

- The textbook should align with the objectives of the National Curriculum of Pakistan.
- The author should consider the cognitive level of the students for whom the textbook is written.
- The textbook's length should be reasonable and manageable.
- Content should not be overcrowded or overly condensed.
- To enhance readability, information should be divided into smaller sections with appropriate headings.
- The textbook must provide accurate and up-to-date information.
- Content should be arranged logically, progressing from simple to complex, familiar to unfamiliar, and concrete to abstract concepts.
- The text should be clear, concise, and free from ambiguities, errors, and misconceptions.
- Every table, diagram, and graph should be properly labeled.
- Footnotes and side notes may be included where necessary to clarify concepts.

## Textbook Style and Structure

Unit Opening	
Unit Outline	Include list of headings.
Student Learning Outcomes	One SLO for each heading may be included. If they are numerous then a reasonable number is acceptable.
Real Life Relevance	Illustrate real-life relevance of the unit, if possible.
Short Introduction	Explain what this unit covers and why.

Unit Body	
Key Terms	Use italics for emphasis and bold for key terms. Define key terms when first introduced and collate them with their definitions for the glossary.
Running Glossary	Key terms and definitions may be pulled out from the main body of text so that students spot them easily in the unit body (e.g., in the margins).
Feature Boxes	Regular feature boxes may include various contents such as a mathematical formula, a working rule or a statement of theorem.
Illustrative Examples	Include illustrative examples to develop conceptual understanding of the topic.
Problem Sets	Special attention should be paid on preparation of Problem Sets. Correlate Mathematics with real life situations and include sufficient exercises almost in every problem set, if appropriate. Questions on the application of Mathematics in other fields of study are also very useful.

Learning Review Points	Include bulleted questions for students to check their understanding at regular intervals. Possible labels include ‘self-test point’ or ‘checkpoint’.
Tips or Hint	Separated from the main body of text, they allow the author to speak directly to the student, offering useful advice or flagging important points.
Visuals	Tables, graphs, line drawings and lists may be used to break up the text.

<b>Unit Ending</b>	
Problem Set (Review)	Include multiple-choice questions, interpretive exercises and fill-in items. Students may also be asked to label diagrams or write a one-word answer to short summary question.
Summary	Include a review of the main concepts. This can relate to the SLOs by covering each in turn (bullet points work well). The summary should not include any new information.

<b>End of Textbook</b>	
Glossary	Include only the key terms in the glossary.
Answers to Problems	Include answers to the problem sets unit wise.
Appendices	Include extra information the student needs such as list of mathematical formulas, log tables and relevant websites.
Bibliography	Include bibliography and list of books for suggested reading where appropriate.
Index	Include index for the key terms used in the book.

## II. **The Teacher’s Manual**

A teacher’s manual should accompany the textbook. It serves to guide teachers on how the textbook is structured and how best to use it to facilitate student learning. Additionally, it supports professional development by providing explanations of key concepts and effective teaching strategies.





A well-designed teacher's manual should:

- Be easy to understand and use.
- Help teachers deliver lessons effectively and extend learning activities.
- Provide sequenced instructions for each activity.
- Include relevant teaching and learning resources.
- Offer a question bank with varied questions beyond the textbook, along with interactive quizzes for each unit.
- Present up-to-date and effective teaching strategies, explaining their rationale.
- Guide teachers on how to implement each strategy.
- Identify potential challenges and strengths of different teaching approaches.
- Recommend assessment strategies to evaluate student learning.

### **III. The Digital Resources /AI Tools**

The use of the World Wide Web (WWW) is rapidly growing, providing access to a vast and ever-evolving pool of information. Its ease of use makes the internet readily accessible to students, even with minimal computer knowledge. Through the web-based links below, teachers, parents, and students can:

- Access various mathematics-related websites worldwide.
- View three-dimensional figures, graphics, lesson plans, activities, and relevant books.

## References

### Websites

#### Title of Website

A+Math

AAA Math

Academic Info-Mathematics

Algebra Buster

Algebra Helper

Class Zone

Click on Bricks

Cool Math

Discovery School (Maths)

Frank Potter's Science Gems-  
Mathematics

Funbrain

Geometry

Internet Mathematics Library

Math Archives

Math Glossary

Math Goodies

Math World

Math2

Mathematical Interactivities

Math Stories

Mega Mathematics

Purple math

S.O.S. Mathematics

Superkids Educational Software Review

Review Teaching made Easier

Web math

#### Universal Resource Locator (URL)

<http://www.aplusmath.com/>

<http://www.aaamath.com/>

<http://www.academicinfo.net/math.html>

<http://www.algebra-online.com/>

<http://www.algebrahelp.com/index.jsp>

[http://www.classzone.com/math\\_middle.cfm](http://www.classzone.com/math_middle.cfm)

<http://kathyschrock.net/clickonbricks/index2.html>

<http://www.coolmath.com/>

<http://school.discovery.com/lessonplans/math.html>

<http://www.sciencegems.com/math.html>

<http://.finbrain.com/numbers.html>

<http://www.mathleague.com/help/geometry.html>

<http://www.mathforum.org/library>

<http://www.archives.math.utk.edu/>

[http://www.harcourtschool.com/glossary/math\\_advantage](http://www.harcourtschool.com/glossary/math_advantage)

<http://www.mathgoodies.com>

<http://www.mathworld.wolfram.com>

<http://www.math2.org/>

<http://mathematics.hellam.net/>

<http://www.mathstorie.com>

<http://www.c3.lanl.gov/mega-math/>

<http://www.purplemath.com/internet.htm>

<http://www.sosmath.com>

<http://www.superkids.com/aweb/tools/math/index.shtml>

<http://www.teachingmadeeasier.com/math.html>

<http://www.webmath.com/>

**Note:** Teachers and students may search more websites and U-Tube Channels for the educational purposes.

### AI Tools

Wolfram Alpha, GeoGebra, Mathway, Microsoft Math Solver, Algebra, Sumbolab etc.

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**NOTIFICATION**

F.No.2-10(2025)/Func/Math(9-12)NCC: In exercise of the powers conferred under the Federal Supervision of Curricula, Textbooks and Maintenance of Standards of Education Act, 1976 Section 3 (2) (a), the competent authority i.e. Director, NCC Wing, M/o FE&PT has approved the Curriculum for "**Functional Mathematics**" for Grades IX-X for technical stream of education. The curriculum will be implemented in all Public and Private Educational Institutions of Islamabad Capital Territory (ICT) and the educational institutions under Federal Government across the country w.e.f academic year 2025-26. This curriculum is available at [ncc.gov.pk](http://ncc.gov.pk)

  
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