Mathematics Syllabus, Grades 10

Introduction

Mathematics learning in grade ten has to significantly contribute towards the fulfillment of the main objectives of learning mathematics. In this respect, developing high level abilities and competencies in calculating is one of the main tasks of learning Grade 10 mathematics. Students should be in a position to tackle problems in an effective way, including estimations, rough calculations and checking the exactness of the result. The use of polynomial, exponential, logarithmic and trigonometric functions for describing phenomena in nature and society and solving respective real life problems should be realized and appreciated by students.

Since improving the linguistic abilities of students and the development of their communication skills serves in the development of their mathematical understanding, emphasis has to be given to group activities and the correct use of mathematical symbolism and language. Students should be in a position to recognize that the use of mathematical symbols make it easier to identify the structure of complicated phenomenon and to make mental work more effective and rational.

Objectives

After studying grade 10 mathematics, students should be able to:

- Define polynomial functions and apply the theorems on polynomials to solve related problems.
- Sketch the graphs of various polynomial functions.
- Apply basic concepts of exponential and logarithmic functions to solve related problems including real life problems.
- Solve linear in equalities involving absolute value, and having two variables.
- Solve quadratic inequalities.
- Apply distance formula to solve related problems
- Determine the slope (gradient) of a given line
- Determine the equation of a given line.
- Apply the properties of the slopes of parallel and perpendicular lines to solve related problems.
- Determine the equation and sketch the graph of a circle given appropriate information.
- Sketch the graphs of basic trigonometric functions.
- Identify and use trigonometric identities.
- Solve real -life problems involving trigonometric functions.
- Define and deal with the reciprocals of the basic trigonometric functions.

Unit 1: Polynomial Functions *(20 periods)*

Unit outcomes: Students will be able to:

- define polynomial functions
- perform the four fundamental operations on polynomials
- apply the theorems on polynomials to solve related problems
- sketch the graphs of polynomial functions

Competencies	*Contents*	*Teaching / Learning Activities and Resources*	*Assessment*
Student will be able to: • define the polynomial function of one variable • identify the degree, leading coefficient and constant terms of a given polynomial functions. • give different forms of polynomial functions • perform the four fundamental operation on polynomials	***1. Polynomial Functions*** **1.1 Introduction to polynomial functions** *(5 periods)* • Definition of Polynomial function • Operations with polynomial functions.	• start the lesson by discussing about identification of some types of functions from a list of functions like: linear, constant, quadratic functions. • State the formal definition of polynomial function and discuss related terms (like: degree, leading coefficient and constant term) by using several examples. • Assist students in adding, subtracting multiplying and dividing polynomial functions • Guide students to determine whether the resulting expression (function) is a polynomial or not and to determine its domain and range.	• After giving a list of several functions, ask students to identify the type of a function by giving good reason for their answer. • You can give exercises on identifying the degree, the coefficients, the leading coefficient the constant terms of several polynomial functions. • Ask students to find the sums, differences, products and quotients of polynomial functions • You can ask students about their generalization about the degree of the sum, product, difference and quotient of two polynomial functions.
• State and prove the polynomial division theorem • apply the polynomial division theorem	**1.2 Theorems on polynomials** *(6 periods)* • Polynomial division theorem.	• You may start the lesson by revising the division algorithm for real numbers and then analogously after stating the Polynomial Division Theorem discuss its proof. • Guide the students to practice the application of the Polynomial Division Theorem using examples and exercises. • Let the student conclude the relationship between the degree of the dividend, the divisor and the remainder expressions.	• Ask students to divide one polynomial by another and see how they apply the theorem property.

Competencies	*Contents*	*Teaching / Learning Activities and Resources*	*Assessment*
• State and prove the Factor Theorem • apply the Factor Theorem	• The Remainder Theorem	• Let the students divide a polynomial p(x) by "x - a" and guide them to compare the remainder with p(a). • State "The Remainder Theorem" and encourage the students to prove it. • Assist Students to apply "The Remainder Theorem"	• Give exercise problems on the application of the remainder theorem and check their works.
• State and prove the Factor Theorem • apply the Factor Theorem	• The Factor Theorem	• You can start the lesson by considering the division of a polynomial P(x) by "x - a" which results in zero remainder, and then guide the students to write the result as • P(x) = (x - a) Q(x) where Q(x) is the quotient. • State "The Factor Theorem" and encourage the students to prove it. • Assist the students to apply "The Factor Theorem" such as in factorizing a given polynomial.	• Ask students to factorize a given polynomial (which is factor able) by using the factor theorem.
• determine the zero(s) of a given polynomial function.	**1.3 Zeros of a Polynomial Function** *(4 periods)*	• You can start the lesson by revising how to find solutions of linear and quadratic equations, and in relation to this introduce what is meant by the "Zero(s) of a linear function or a quadratic function". • State the formal definition of "Zero(s) of a Polynomial Function" and help students to determine zero(s) of some polynomial function.	• Ask students to find zero(s) of a given polynomial function (the given exercise problem may suggest the use of appropriate theorem stated above)
• State the Location Theorem • apply the Location theorem to approximate the zero(s) of a given polynomial function	• Location Theorem	• State and discuss the Location theorem by using several examples. • encourage the students to approximate the zero(s) of some polynomial functions by using the location theorem.	• Give students exercise problem on the application of the location theorem and check their performance.
• apply the rational root test to determine the zero(s) of a given polynomial function.	• Rational root test	• State the rational root test and discuss on how to use it in determining the zero(s) of a given polynomial functions. • assist the students to practise the application of rational root test.	• Give exercise problems on the application of the rational root test.

Competencies	***Contents***	***Teaching / Learning Activities and Resources***	***Assessment***
• Sketch the graph of a given polynomial function. • describe the properties of the graphs of a given polynomial function.	**1.4 Graphs of polynomial functions.** *(5 periods)*	• You may start the lesson by setting an activity that allows students to construct table of values for a given polynomial function. • Assist students to sketch the graph of a given polynomial function using tables of values they make above. • Let students practise sketching the graphs of different polynomial functions. • Assist students to describe some of the properties of the graphs of some polynomials.	• You can ask students to describe the properties of a given polynomial function using its graph.

Unit 2: Exponential and Logarithmic Functions *(30 periods)*

Unit outcomes: Students will be able to:

- understand that the laws of exponents are valid for real exponents
- know specific facts about logarithms
- know basic concepts about exponential and logarithmic functions
- solve mathematical problems involving exponents and logarithms

Competencies	*Contents*	*Teaching / Learning Activities and Resources*	*Assessment*
Students will be able to: • Explain what is meant by exponential expression • State and apply the properties of exponents (where the exponents are real numbers)	***2. Exponential and Logarithmic Functions*** **2.1 Exponents and logarithms** *(6 periods)* **2.1.1 Exponents** • Revision on the properties of exponents	• Revise the notion "power" in a form of class discussion. Students should be assisted to recall power, base and exponent. • Assist students to show the validity of the properties of exponents for real exponents such as: 1. $a^x \cdot a^y = a^{x+y}$ 2. $\frac{a^x}{a^y} = a^{x-y}$ 3. $(a^x)^y = a^{xy}$ 4. $a^x b^x = (ab)^x$ 5. $\frac{a^x}{b^x} = \left[\frac{a}{b}\right]^x$ 6. $a^{-x} = \frac{1}{a^x}$ using different examples • Encourage students to apply the above properties and simplify exponential expressions.	• Ask students to apply the laws of exponents in simplifying exponential expressions.
• Express what is meant by logarithmic expression by using the concept of exponential expression. • Solve simple logarithmic equation by using the properties of logarithm	**2.1.2 Logarithms** • Properties of logarithms	• Define the notion logarithm with the active participation of students that is $\log_a^b = c$ if and only if $a^c = b$. Assist students to determine the logarithm of a given number to a given base by using different examples • State the properties of logarithms i.e. (i) $\log c^{ab} = \log_c^a + \log c^b$ (ii) $\log_c^{a/b} = \log_c^a - \log_c^b$ (iii) $\log_c^{ab} = b \log_c^a$ by using (iv) $\log_c^c = 1$ (v) $C^{\log_c^b} = b$ and encourage the students to justify these properties by giving their own examples.	• Ask students to change a given exponential expression to logarithmic expression. • Ask students to simplify logarithmic expression by using the properties. • Give exercise problems on finding logarithm of a number (whose logarithm is simple to determine)

Competencies	*Contents*	*Teaching / Learning Activities and Resources*	*Assessment*
• recognize the advantage of using logarithm to the base 10 in calculation • identify the "characteristics" and "mantissa" of a given common logarithm • use the table for finding logarithm of a given positive number and antilogarithm of a number. • Compute using logarithm	• Common logarithms	• Discuss with students the possibility of using different bases in computing with logarithms and facilitate for students to realize the advantage of using logarithms to the base 10. • After introducing what is meant by "common logarithm" use several examples in order to describe related terms such as "mantissa" and "characteristics" of a given logarithm. • Assist students to read the mantissa of a logarithm from the table of logarithm • After explaining what is meant by "Antilogarithm" of a number, guide students how the table is used in finding antilogarithm of a given number • Encourage students to evaluate (compute) expressions like: $(0.52)^8$ using common logarithm.	• Give exercise problems on determining the mantissa and characteristics of a given logarithm • Ask students to find the antilogarithm of a given number. • Let the students compute or evaluate the value of a mathematical expression like a) $5\sqrt{76\ .98}$ b) $(0.4873)^{2/}{}_3$ by using logarithm
• Define an exponential function. • Draw the graph of a given exponential function.	**2.2 The exponential functions and their graphs** *(5 periods)* • Exponential functions	• Revise the notion "function" and types of functions with appropriate examples.	• Ask students to list the properties of an exponential function by examining its graph and check their answer/ feedback.
• Describe the graphical relationship of exponential functions having bases reciprocal to each other. • describe the properties of an exponential function by using its graph.	• Graphs of exponential functions.	• State the formal definition of an exponential function and discuss on the restriction of the base. (i.e. define an exponential function as $f(x) = a^x$ like: (where $a > 0$ and $a \neq 1$) • After demonstrating a sample graph, students should be encouraged and assisted in drawing and enlisting the properties of graphs of the functions. like: $f(x) = 2^x$ and $f(x) = (½)^x$ $y = 10^x$ and $y = (1/10)^x$ as representative of the functions. $y = f(x) = z^x$ ($X \varepsilon R$, $a > 0$ and $a \neq 1$) • Assist the students to give different examples of exponential functions and then to discuss the respective properties of the functions by sketching the graph of each (i.e. domain, range, y - intercept, and the behavior of the graph based on the base).	

Competencies	*Contents*	*Teaching / Learning Activities and Resources*	*Assessment*
		• After introducing the irrational number "**e**", (including its historical background) discuss the properties of the function f given by $f(x) = e^x$ and then sketch the graph. • encourage and assist students to apply the graph of $y = e^x$ to approximate the value of e^k where K is any real number.	• Give exercise problems from real life which involves the application of natural logarithm (e.g. multiplication or reproduction of bacteria)
• define a logarithmic function • draw the graph of a given logarithmic function	**2.3 The Logarithmic Functions and their Graphs** *(6 periods)* • Logarithmic Functions	• Revise the relationship of exponential equation and its corresponding logarithmic equation by using several examples.	• Give exercise problems on logarithmic function
• describe the properties of a logarithmic function by using its graph • describe the graphical relationship of logarithmic function having bases reciprocal to each other.	• Graphs of Logarithmic Functions	• State the formal definition of a logarithmic function and discuss the restriction on the domain and the base (i.e., define a logarithmic function as $f(x) = \log_a x$ where $x > 0,\ a > 0, a \neq 1$) • After demonstrating a sample graph, assist and encourage your students to draw and enlist the properties of graphs of functions like $f(x) = \log_2 x,\ f(x) = \log_{½} x,\ y = \log_{10} x$ and $y = \log_{1/10} x$ as representative functions for $y = f(x) = \log_a x$ $(x > 0, a > 0$ and $a \neq 1)$ • Assist the students to give different examples of logarithmic functions and also to discuss the respective properties (i.e., domain, range y - interest and the behaviour of the graph in relation to reciprocal bases and for $x \to \infty$ and $x \to 0$) • discuss the properties of the function given by $f(x) = \log_e x$ (or $y = \ln x$) using its graph.	• Ask students to some properties of logarithmic functions by using (students my use graph) and analyse their feedback.
• describe how the domains and ranges of $y = a^x$ and $y = \log_a x$ are related	• Relation between the functions • $y = a^x$ and $y = \log_a x$ $(a > 0$ and $a \neq 1$	• You may start the lesson by considering the functions $Y = 2^x$ and $y = \log_2 x$ and assist the students to construct table of values for each of these functions and let them conclude what they observe from these tables (how the values of x and y are interchanged)	• Give exercise problems on the relation of these functions (exponential and logarithmic) having the same base, you can set the problems.
• explain the relationship of the graphs of $y = a^x$ and $y = \log_a x$		• Assist students to sketch the graphs of the above functions on the same coordinate plane and ask them to write a statement on how the graphs are related (i.e. one of the graphs can be obtain by reflecting the other along the line y = x)	

Competencies	*Contents*	*Teaching / Learning Activities and Resources*	*Assessment*
		• Help the students in solving several exercises on sketching graphs of exponential and logarithmic functions (pair wise) having the same bases on the same coordinate plane and guide the students to realize that the relationship of these functions hold true for any pair of functions given by $y = a^x$ and $y = \log_a{}^x$ where $a > 0, a \neq 1$.	
• solve equations involving exponents • solve equation involving logarithms	**2.4 Equations involving exponents and logarithms** (7 *periods)* • Exponential equations • Logarithmic equations	• You may start the lesson by revising the properties of exponents, which were discussed in the first section of this chapter and introduce the property "if **$b > 0, b \neq 1$** and m and n are real numbers, then **$b^n = b^m$** if and only if **$n = m$** " • Consider simple exponential equation and discuss the technique of solving it you may take examples like: e.g solve for x, if (a) $e^x = 81$ (b) $= (2/_3)^x = 3/_2$ So/n :- (a) $3^x = 81$ $3^x = 3^4$ ----- $(81 = 3^4)$ $\therefore x = 5$ ----- (if $b^n = b^m$, then n = m) (b) $(2/_3)^x = (3/_2)$ $(2/_3)^x = (2/_3)^{-1}$ -------- $[3/_2 = (2/_3)^{-1}]$ $\therefore x = -1$ • After revising the properties of logarithms, consider some simple logarithmic equations and discuss the techniques in solving it you may take examples like: e.g. log 5 + logx = 1	
• Solve problems, involving exponential and logarithmic functions, from real life.	**2.5 Application of Exponential and Logarithmic functions** *(6 periods)*	• Assist and encourage students to solve problems on practical applications of exponential and logarithmic function from different fields such as population growth, compound interest, etc.	• Give several exercise problems and analyse the feed back (the problems can be taken from appropriate field of studies)

Unit 3: Solving Inequalities *(20 periods)*

Unit outcomes: Students will be able to:

- know and apply methods and procedures in solving problems on inequalities involving absolute value.
- know and apply methods in solving system of linear inequalities
- apply different techniques of solving quadratic inequalities.

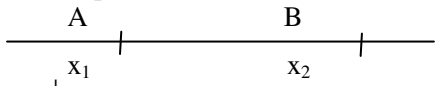
Competencies	*Contents*	*Teaching / Learning Activities and Resources*	*Assessment*
Students will be able to: • describe sets using internal notation. • Solve inequalities involving absolute value of linear expression	***3. Solving Inequalities*** **3.1 Inequalities involving absolute values** *(4 periods)*	• Revise different ways of describing sets that the students had learnt in Grade 8 and introduce the interval notation (i.e. open, half closed and closed intervals) using several examples. • You may start the lesson by revising the definition of absolute value and how to solve equation involving absolute value of linear expression like $\lvert 3x - 1 \rvert = 5$ • Assist students to solve inequalities of the form $\lvert ax + b \rvert \leq c$, $\lvert ax + b \rvert \geq c$, $\lvert ax + b \rvert < c$ and $\lvert ax + b > c \rvert$ where c is a non-negative real number by giving them several examples and exercises.	• Ask students to solve inequalities involving absolute value of different linear expression and observe their feed back • Let the students give their answer in interval notation
• Solve system of linear inequalities in two variables by using graphical method	**3.2 Systems of linear inequalities in two variables** *(5 periods)*	• Let the students revise sketching of the graphs of relations like $R = \{(x, y) : y \leq x + 1 \text{ and } y > 1 - x\}$ • Guide students to find the solution for system of linear inequalities graphically. You may consider examples like: **e.g** Solve the following system of inequalities. $\begin{cases} y + x > 0 \\ y - x \leq 1 \\ x \leq 2 \end{cases}$ **Note:** The system should not have more than three linear inequalities	• Give different exercises problems on system of linear inequalities and check students work (let students to give their answers in interval notation as well)
• Solve quadratic inequalities by using product properties	**3.3 Quadratic Inequalities** *(11 periods)* • Solving quadratic inequalities using the product properties	• You can start the lesson by defining quadratic inequalities where the quadratic expression is given in its general form and as a product of two linear expressions, i.e. (i) $ax^2 + bx + c \geq 0$ (ii) $(ax + b)(x - c) \leq 0$	• Ask students to solve different quadratic inequalities using product property and check whether they use (apply) this property correctly.

Competencies	***Contents***	***Teaching / Learning Activities and Resources***	***Assessment***
• Solve quadratic inequalities using the sign chart method. • Solve quadratic inequalities using graphs	• Solving quadratic inequalities using the sign chart method • Solving quadratic inequalities graphically	• Discuss the product property i.e. (i) M.N > 0 means M > 0 and N > 0 or M < 0 and N < 0 (ii) M.N < 0 means M > 0 and N < 0 or M < 0 and N > 0 • encourage your students to apply the above product property in solving quadratic inequalities. • Show the students how the sign chart can be prepared and discuss its application by considering simple examples such as e.g (x + 3) (x - 2) > 0 e.g. $x^2 + 1 > 0$ $x^2 + 3x + 5 < 0$	• Give several exercise problems on the application of the two methods discussed in the lesson.

Unit 4: Coordinate Geometry *(15 Periods)*

Unit outcomes: Students will be able to:

- apply distance formula to find distance between any two given points in the coordinate plane.
- formulate and apply section formula to find a point that divides a given line segment in a given ratio
- write different forms of equations of a line and understand related terms.
- describe parallel or perpendicular lines in terms of their slopes
- write equation of a circle

Competencies	*Contents*	*Teaching / Learning Activities and Resources*	*Assessment*
Students will be able to: • derive the distance formula (to find distance between two points in the coordinate plane) • Apply the distance formula to solve related problems in the coordinates plane	***4. Coordinate Geometry*** **4.1 Distance between two points** *(2 periods)*	• You can start the lesson by discussing how to find the distance between two points on a number line.  i.e. AB = $\lvert x_2 - x_1 \rvert$ gives the distance between points A and B. • encourage students to derive and apply the distance formula which is used to find distance between any two points in the coordinate plane.	• Give exercise problems on computing distance between two points, i.e., by applying distance formula.
• determine the coordinates of points that divide a given line segment in a given ratio.	**4.2 Division of a line segment** *(2 periods)*	• You may start the lesson by considering a horizontal line segment with end points A(x_1, y) and B (x_2, y) and discuss how to determine the coordinate of a point P that divides AB in a given ration m:n internally • Write the statement about a point "ρ(x,y)" that divides any given line segment (say AB in the ratio m:n and derive the "section formula". • Let students infer that the "mid point formula" is a special case of the section formula.	• Give several exercises and problems on the application of section formula. • Ask students to justify that "mid point formula" is a special case of section formula.
• define the gradient of a given line • determine the gradient of a given line (given two points on the line) • express the slope of a line in terms of the angle formed by the line and the x-axis	**4.3 Equation of a line** *(8 periods)* • Gradient (slope) of a line	• Assist students to practice the section formula in finding the coordinates of a point that divides a given line segment in a given ratio by using several examples (exercises) • You may start the lesson by defining what is meant by "Gradient (slope) of a line", and discuss how the slope of a line is expressed in terms of the tangent of a positive angle,θ, formed by the line and the x-axis (where θ is measured from the x-axis)	• Ask students to find the slope of a line by taking several pairs of points from it and ask what they can infer form their work.

Competencies	*Contents*	*Teaching / Learning Activities and Resources*	*Assessment*

• determine the equation of a given line
•
	• Slope of a line in terms of angle of inclination
	• Different forms of Equations of lines
		• By considering arbitrary line on the coordinates, plane and by active participation of the students derive and state the formula for slope of the line.
		• Assist students to conclude that the slope a line does not depend on the choice of coordinates of points on the line (i.e., the uniqueness of the slope).
		• Guide and encourage students to determine slopes of different lines and let them observe the nature of the line in relation to the slope i.e.
		1) if m ε $\Re$ and
		  • m > 0, then the line rises from left to right
		  • m < 0, then the line goes down ward from left to right
		  • m = 0, then the line is horizontal
		2) a vertical line has no slope
		• Discuss on the different forms of equations of a line, i.e., two point form, slope intercept form and point slope forms of equations.
		• Assist students to practice writing these forms of equations of a line through sufficient exercises.
			• Ask students how to determine whether a given point is on a given line or not.
			• Give several exercises and problems on equations of a line (such as changing one form of the equations in the other form)

• identify whether to lines are parallel or not. • identify whether two lines are perpendicular or not. • apply the properties of the slopes of parallel and perpendicular lines to solve related problems	**4.4 Parallel and perpendicular lines** *(3 periods)* • Slopes of parallel and perpendicular lines.	• You can start the lesson by taking two parallel lines on the coordinates plane and writing their equations, discuss with students how their slopes are related. • As suggested above you may do the same thing for perpendicular lines. • State and prove theorems on the slopes of parallel and perpendicular lines. • Allow students to solve problems involving the properties of the slopes of parallel and perpendicular lines.	• Give exercise problems on determining whether a given pair of lines are parallel or perpendicular or neither of them. • Ask students to state and prove the converse of the two theorems.

Unit 5: Trigonometric Functions *(30 periods)*

Unit outcomes: Students will be able to:

- know principles and methods in sketching graphs of basic trigonometric functions.
- understand important facts about reciprocals of basic trigonometric functions.
- identify trigonometric identities
- solve real life problems involving trigonometric functions.

Competencies	*Contents*	*Teaching / Learning Activities and Resources*	*Assessment*
Students will be able to: • define the sine, cosine and tangent functions of an angle in the standard position. • determine the values of the functions for an angle in the standard position, given the terminal side of that angle. • determine the values of the sine, cosine and tangent functions for quadrantal angles • locate negative and positive angles by identifying the direction of rotation • determine the values of trigonometric functions for some negative angles.	***5. Trigonometric Functions*** **5.1 Basic trigonometric functions** *(15 periods)* **5.1.1 The sine, cosine and tangent functions** • In standard position • Using the unit circle • Trigonometric values of positive and negative angles	• You can start the lesson by defining the sine, cosine and tangent functions by considering an angle θ in the standard position and a point P(x,y) on its terminal side on the coordinate plane, in doing so, remind them the ratios they had seen in grade 8, so that they can relate those ratios with the definitions given here. • Using some examples let the students evaluate the values of the functions for a given angle θ in the standard position and with its terminal side containing a certain coordinate, you may take examples like: e.g Given the terminal side of θ containing (3,4) then determine sin θ, cos θ and tan θ. • Guide students to contract a unit circle and using it let them determine the values of the sine, cosine and tangent functions for quadrantal angles (i.e., 0°, 90°, 180^0, 270°, 360°) and also assist them to approximate the values of these functions for special angles, i.e. 30°, 45° and 60°. • Discuss with your students how to locate negative angles in relation to the corresponding positive angles. • Allow students to determine the trignometrical values of -30°, -45°, -60°, -90°, -180°, -270° and -360° • By using the unit circle guide the students to reach on cos (-θ) = cos θ, sin(-θ) = -sin θ and tan(-θ) = -tan θ.	• Ask students to use the definition given in grade 8 and describe the sine, cosine and tangent of an angle, θ, given in standard position • Give exercise problems on evaluating (or approximating) the triogonometrical values of angles by using the unit circle on the coordinates plane and check their answers. • Ask students to give their own conclusion about the trigonometrical values of angles having equal measures but opposite in signs.

Competencies	*Contents*	*Teaching / Learning Activities and Resources*	*Assessment*
• determine the algebraic signs of the sine, cosine and tangent functions of angles in different quadrants. • describe the relationship between trigonometrical values of complementary angles.	**5.1.2 Values of Trigonometric functions for related angles** • Algebraic signs of sine, cosine and tangent • Complementary angles.	• You may start the lesson by considering different angles in each quadrant, and helping the students to determine the trigonometircal values of these angles based on the definition. • Based on the results obtained in the above activities, allow the students to put the algebraic sign for value of each function in the respective quadrants (i.e. in quadrants I, II, III and IV). • After a brief revision of complementary angles let the students discuss on the relationship between the trigonometrical values of complementary angles, first by considering 30^0 and 60^0 angles and then by taking any pair of complementary angles. (**Note**: In this case they can use, table of trigonometrical values). ▪ Using the above activities guide students to generalize, that "if θ and β are complementary angles, then $\sin\theta = \cos\beta$, $\cos\theta = \sin\beta$ and $\tan\theta = \frac{1}{\tan\beta}$	• Give enough exercise problems to students and after checking their work ask them to write a summary about the algebraic signs of the values of the trigonometric functions in each quadrant. • Give several exercise problems on the application of the relation between the trigonometrical values of complementary angles as well as supplementary angles.
• describe the relationship between trignonometrical values of supplementary angles.	• Supplementary angles	• After a brief revision of supplementary angles let the students discuss on the relationship between the trigonometrical values of supplementary angles and then encourage them to conclude how the trigonometrical values of supplementary angles are related. (i.e. $\sin\theta = \sin(180°-\theta)$, $\cos\theta = -\cos(180°-\theta)$ and $\tan\theta = -\tan(180°-\theta)$).	
• determine the relationship between trigonometrical values of coterminal angles. • determine the trigonometrical values of large angles	• Co-terminal angles • Large angles	• You may start the lesson by defining what is meant by "coterminal angles" and elaborate the definition by taking different examples • By considering different pairs of coterminal angles whose measures are between -360^0 and 360^0 assist students to generalize the relationship between their trigonometrical values. • Let the students observe that trigonometrical values for angles larger than 360^0 (2π rad.) can be obtained from	• Give enough exercise problems on finding trigonometrical values of co-terminal angles as well as of large angles.

Competencies	*Contents*	*Teaching / Learning Activities and Resources*	*Assessment*
		trigonometrical values of their coterminal acute angles.	
• construct a table of values for $y = \sin\theta$ where $-2\pi \le \theta \le 2\pi$. • draw the graph of $y = \sin\theta$ • determine the domain range and period of the sine function.	**5.1.3 Graphs of the Sine, Cosine and Tangent functions** • The Graph of sine function; $y = \sin\theta$	• You can start the lesson by guiding the students to construct a table of values for $y = \sin\theta$ where $-2\pi \le \theta \le 2\pi$ in doing so you may use the unit circle to read values for quadrantal and/or special angles. • Assist students to sketch the graph of $y = \sin\theta$ where $-2\pi \le \theta \le 2\pi$ and let them use this graph to determine the period of the sine function and encourage them to extend the graph in both direction based on the period of the function. • With the help of the graph encourage students to determine the domain and range of the sine function	• Ask students to list some properties of the sine function by observing the graph they draw, such as - its domain and range - its continuity in the domain - its usage in reading values of angles discussed in section 5.1.3 above
• Construct a table of values for $y = \cos\theta$, where $-2\pi \le \theta \le 2\pi$. • draw the graph of $y = \cos\theta$ • determine the domain, range and period of the cosine function.	• The Graph of Cosine function $y = \cos\theta$.	• All students to repeat the steps followed earlier in sketching $y = \sin\theta$ to sketch the graph of $y = \cos\theta$ and assist them to use this graph in determining the period of cosine function. At the end encourage them to extend the graph in both direction based on the period of the function. • With the help of the graph of $y = \cos\theta$, encourage the students to determine the domain and range of the cosine function.	• Ask students to list some important facts from the graph about the cosine function such as: - its domain and range - its continuity in its domain - its use in finding values for angles discussed in sections 5.1.3 e.g. $\cos\theta$ and $\cos(-\theta)$ • Give other exercise problems
• Construct a table of values for $y = \tan\theta$ where $-2\pi \le \theta \le 2\pi$. • draw the graph the tangent function $y = \tan\theta$. • determine the domain, range and period of the tangent function. • discuss the behavior of	• The Graph of Tangent function, $y = \tan\theta$	• You may start the lesson by guiding the students to construct a table of values for $y = \tan\theta$, where $-2\pi \le \theta \le 2\pi$ in doing so give emphasis to values of θ for which the function is undefined (i.e., for $-\frac{3\pi}{2}, -\frac{\pi}{2}, \frac{\pi}{2}$ and $\frac{3\pi}{2}$ in the interval from -2π to 2π) • Assist students to sketch the graph of $y = \tan\theta$ where $-2\pi \le \theta \le 2\pi$ using the table they construct and let them use	• Ask students to give: - the domain and range of $y = \tan\theta$ - where this function is undefined or for what value of θ does the graph discontinuous (Let the students justify their answer either using the unit circle or the ratio)

Competencies	*Contents*	*Teaching / Learning Activities and Resources*	*Assessment*
the graph of tangent function.		this graph to determine the period of the tangent function. • Based on the period encourage the students to extend the graph of y = tan θ in both direction. • Guide the students to determine the domain and range of the tangent function (to do so you may use the graph of the function) and let them discuss the behaviour of the function using its graph.	• Give some more exercise problems and check their answers
• define the cosecant function • determine the values of cosecant function for some angles. • define the secant function. • determine the values of secant function for some angles. • define the cotangent function • determine the values of cotangent function for some angles.	**5.2 The reciprocals of the basic trigonometrical functions.** *(7 periods)* • The cosecant function. $y = \csc \theta$ • The secant function $y = \sec \theta$ • The cotangent function. $y = \cot \theta$	• You may start the lesson by defining the cosecant function, i.e. using the relationship between sine of θ and cosecant of θ and introduce the notation "csc θ" • Discuss with your students about the values of θ for which csc θ is undefined based on the definition. • Assist students in determining the values of cosecant function for some angles. • You can start the lesson by defining the secant function using the relationship between cos θ and second of θ for the same value of θ after introducing the notation sec θ. • Assist students in evaluating the values of secant function for some angles, in doing so don't forget give emphasis to angles where y = sec is θ undefined. • After defining the cotangent function using the tangent function introduce the notation "cot θ".	• Ask students to restate the definition for each of the reciprocal of the basic trigonometric functions. • Ask students to explain the properties of each reciprocal of basic trigonometric functions.
		• Guide the students in determining the values of cotangent function for some angles and encourage them in differentiating angles whose cotangent is undefined.	• Make students in group to draw rough sketch of each reciprocal trigonometric functions.
• explain the concept of co-functions.	• Co-functions	• By using the idea of reciprocal of trigonometric functions and trigonometrical values of complementary angles introduce the concept of co-function. i.e. $\sin \frac{\pi}{2} - \theta = \cos \theta$ $\sec \frac{\pi}{2} - \theta = \csc \theta$	• Ask students about the functional relationship of the co-functions by giving their own examples

Competencies	*Contents*	*Teaching / Learning Activities and Resources*	*Assessment*
• derive some of the trignometric identities. • Identify the quotient identities • Solve problems related to trigonometrical identities.	**5.3 Simple trigonometrical identities.** *(3 periods)* • Quotient identities	$\tan\left(\frac{\pi}{2} - \theta\right) = \cot\theta$ • Assist students to derive trigonometrical identify $\sin^2\theta + \cos^2\theta = 1$ using unit circle and then encourage them to drive $1 + \tan^2\theta = \sec^2\theta$ and $1 + \cot^2\theta = \csc^2\theta$ from $\sin^2\theta + \cos^2\theta = 1$. • Let students differentiate trigonometrical identity from trigonometrical equation by using different examples. • With active participation of the students discuss about the quotient identities, namely. $\tan\theta = \frac{\sin\theta}{\cos\theta}$ and $\cot\theta = \frac{\cos\theta}{\sin\theta}$	• Give exercise problems on the application of the trigonometric identities in finding value of one of the function while the other is known (given) and check students' work.
• Solve real life problems using trigonometircal ratios	**5.4 Real life application problems.** *(5 periods)* • Angle of elevation and angle of depression	• Allow students to apply trigonometrical ratios and trigonometrical identities in solving related problems. • You can start the lesson by reminding the students about the properties of right angled triangles and the trigonometric ratios on right angled triangles and allow students to practice solving right angled triangles through different exercises. • Introduce the concepts "angle of elevation" and "angle of depression" and give some practical examples on applying these concepts through solving right angled triangles.	• Give exercise problems on the application of trigonometrical ratios in solving real life problems and check students' work.

Unit 6: Plane Geometry *(22 periods)*

Unit outcomes: Students will be able to:

- know more theorems special to triangles.
- Know basic theorems specific to quadrilaterals
- Know theorems on circles and angles inside, on and out side a circle
- Solve geometrical problems on quadrilaterals, circles and regular polygons

Competencies	*Contents*	*Teaching / Learning Activities and Resources*	*Assessment*
Students will be able to: • apply the incidence theorems to solve related problems.	***6. Plane Geometry*** **6.1 Theorems on Triangles** *(5 periods)*	• You may start the lesson by revising concepts about triangles that the students had learnt in previous grades (concepts like: angle bisector, bisector and perpendicular bisector of side of a triangle, altitude of a triangle and other) • State and verify by construction theorems on concurrency of altitudes, medians, angle bisectors and perpendicular bisectors of sides of a triangle, the Altitude Theorem and the Menelaus' Theorem with active participation of students. • Assist students to practice the application of these theorems.	• You can ask to apply coordinate geometry to find the point of concurrency and check their answers. • Give exercise problems on verification of the theorems on concurrency geometrically.
• Apply theorems on special quadrilateral in solving related problems	**6.2 Special quadrilateral** *(6 periods)* • Theorem on special quadrilaterals (Trapezium parallelogram, rectangle, rhombus and square)	• You may start the lesson by revising the definitions and some properties of special quadrilaterals (Trapezium, parallelogram, rectangle, Rhombus and square) • State and prove (by construction and measurement) theorem on these special quadrilaterals with active participation of students. • Help students to practice the application of these theorems through examples and exercises.	• Give exercise problems on construction to prove the theorems and check their answers
• Apply the theorems on angles and arcs determined by lines intersecting inside, on and outside a circle to solve related problems	**6.3 More on Circles** *(6 periods)* • Theorems on angles and arcs determined by lines intersecting inside, on and outside a circle.	• You may start the lesson by discussing about angles and arcs that are formed by two intersecting chords, by two intersecting secants, by two intersecting tangents and by intersecting secants and tangent. • State and prove theorems on angles and arcs determined by lines intersecting inside, on and outside a circle with active participation of the students.	• Give exercise problems on proving the theorems and their application in find the degree measures of angles and arcs and check their work.

Competencies	*Contents*	*Teaching / Learning Activities and Resources*	*Assessment*
• Calculate the perimeters of regular polygons	**6.4 Regular Polygons** *(5 periods)* • Perimeter	• Help students to practice the application of these theorem through examples and exercises. • Assist the students to drive the formula $S = 2r \sin \frac{180^0}{n}$ for side(s) of regular polygon with radius **r** and number of side **n** by reducing the problem back to right angled triangles. Then guide them to drive the formula for perimeter (P) of n sided regular polygon as: $P = ns$ or $P = 2nr \sin \frac{180^0}{n}$ • Motivating and assisting students in solving practicable problems demanding the application of these formulas.	▪ Give exercise problems on the application of the formulae. ▪ Ask students to find their own ways of computed either the side or the perimeters of a given regular polygon with out using the formulas and encourage them to do this.
• Calculate the areas of regular polygons	• Area	• First assist the students to drive the formula $A = \frac{1}{2}ab\sin\hat{C}$ for the area of a triangle by dividing (resolving) the given triangle into two right angled triangles, and expressing the height with the trignometric ratios. Then • Guide the students in driving the area formula of a regular polygon by using the area formula of a triangle derived above. That is: $A = \frac{1}{2} nr^2 \sin \frac{360^0}{n}$ • Assisting students in applying the formula $A = \frac{1}{2} nr^2 \sin \frac{360^0}{n}$ of a regular polygenic in solving related problems.	• Ask students to compute by themselves the area of a give regular polygon by using their previous knowledge about areas of different plane figures. • Give exercise problems on the application of the formulas and check the works of the students.

Unit 7: Measurement *(25 periods)*

Unit outcomes: Students will be able to:

- solve problems involving surface area and volume
- know basic facts about frustums of cones and pyramids

Competencies	*Contents*	*Teaching / Learning Activities and Resources*	*Assessment*
Students will be able to: • apply the formulae for calculating surface area and volume of prism and cylinder	***7. Measurement*** **7.1 Revision on surface area and volume of prisms and cylinders.** *(3 periods)*	• You may begin the lesson with a brief revision on what the students had learnt about prism and cylinder in earlier grades and then state the formulae for surface area of prism and cylinder. • Assist students to apply the formulae in order to calculate the surface area of prism and cylinder. • After discussing the formulae for calculating the volume of prism and cylinder, assist students to apply these formulae to find the volume of prism and cylinder.	• Ask students oral question about what they can remember from their earlier grades. • Give students exercise problems on the application of the formulae and check their work.
• Calculate surface areas of a given pyramid or a cone • calculate the volumes of a given pyramid or a cone.	**7.2 Pyramids, Cones and Sphere** *(8 periods)* ▪ Pyramids and cones	• You may start the lesson by revising important points about pyramids and cones that the students had learnt in earlier grade, in doing so, it is better to use models of the solid figures. • By using several examples discuss with students the derivation of the formulae that is used to calculate the surface areas of pyramids and cones and assist students to use these formulae in order to find surface areas of the respective solid figures. • Similarly discuss with the students the derivation of the formulae for calculating volumes of pyramids and cones encourage students to apply these formulae to calculate the volumes of these solid figures.	• Give students exercise problems on the application of the formulae for calculating surface area and volumes of pyramids and cones. • After analyzing their feed back or check their work try to give more concept building exercises by reducing that requires more computation.
• Calculate the surface area of a given sphere • Calculate the volume of a given sphere	• Spheres	• By using the model of sphere revise main ideas about sphere that the students had learnt in the earlier grades. • After stating the formulae for calculating surface area and volume of spheres encourage the students to calculate the surface area and volume of a given sphere by using the respective formulae.	• Ask oral question about sphere that the students can remember from their earlier grades. • Give exercise problems on the application of the formulae.

Competencies	*Contents*	*Teaching / Learning Activities and Resources*	*Assessment*
• define frustums of a pyramid and of a cone. • calculate the surface areas of frustums of pyramids of cones. • calculate the volumes of pyramids or of cones.	**7.3 Frustums of pyramids and cones** *(7 periods)*	• You may start the lesson by discussing how frustums of pyramids and cones are generated and then define what is meant by "frustum of a pyramid and frustum of a cone" and use model of frustum. • Discuss with students the derivation of the formulae for calculating the surface areas of frustum of pyramids and frustum of cones and then state the formulae as a result of the discussion. • Encourage the students to apply these formulae to calculate surface areas of a given frustum (either of a pyramid or of a cone). • You may follow the same steps, as you did for formulae of surface areas of frustums, to derive the formulae for volumes of frustums of pyramids and of cones. • State the formulae for the volume of frustums as a result of the discussion and encourage students to carry out calculation on volumes of frustums (either of pyramids or of cones) in doing so don't forget to relate the exercises with real life problems.	• Ask students some oral questions on important ideas during the class discussion and analyse their feed back. • Give exercise problems on the application the formulae for surface area and volume of
• determine the surface area of simple composed solids. • Calculate volumes of simple composed solids	**7.4 Surface areas and volumes of composed solids** *(7 periods)*	• You may start the lesson by introducing solid figures formed by two solids having different shapes. • Assist students to compute the surface areas and volumes of some simple composed solid figures, in doing so it is better to produce a model of some of these solids.	• Ask students to mention some composed solid figures from their environment. • Give students exercise problems on the computation of surface area and volume of different composed solid figures and check their work. • Let the students use their own ways of computation and ask why they use the method.