National School Curriculum

MATHEMATICS CURRICULUM FRAMEWORK

Classes PP-XII

ཤེས་རིག

"Your parents, relatives, and friends would be very proud of what you have achieved. At your age, to have completed your studies is your personal accomplishment. Your knowledge and capabilities are a great asset for the nation. I congratulate you for your achievements.

Finally, your capabilities and predisposition towards hard work will invariably shape the future of Bhutan. You must work with integrity, you must keep learning, keep working hard, and you must have the audacity to dream big."

- His Majesty Jigme Khesar Namgyel Wangchuck

National School Curriculum

MATHEMATICS CURRICULUM FRAMEWORK

Classes: PP-XII

ཤེས་རིག

School Curriculum Division
Department of School Education
Ministry of Education and Skills Development
Royal Government of Bhutan

Acknowledgements

13. Mr. Kinley Wangdi, Drukgyel HSS, Paro
14. Mr. Pasang Dorji, Gesarling CS, Dagana
15. Mr. Norbu Wangdi, Kuzhugchen MSS, Thimphu
16. Mr. Khemnath Sharma, Bjimethangkha PS, Wangduephodrang
17. Mr. Sonam Phuntsho, Jakar HSS, Bumthang
18. Mrs. Dorji Dolma, Bjimina PS, Thimphu
19. Mr. Ugyen Kelzang, Gelephu MSS, Sarpang
20. Mrs. Sonam Chozom, Phuentsholing MSS, Chhukha
21. Mr. Karma Tenzin, Dekiling MSS, Sarpang
22. Mrs. Pema Choden, Pakshikha CS, Chhukha
23. Mr. Pelden Dorji, Gosarling PS, Tsirang
24. Mr. Needup Dorji, Lhuentse PS, Lhuenste

Review and writing (2023)

1. Mr. Tashi Dendup, Curriculum Developer, School Curriculum Division, DSE,MoESD
2. Mrs. Pema Yangzom, Tsimalakha MSS, Chhukha
3. Mrs. Sonam Choden, Tshaphel LSS
4. Mrs. Sonam, Sinchula PS, Chhukha
5. Mrs. Norbu Zangmo, Lobneykha PS, Chhukha
6. Mr. Phub Dorji, Tshaphel LSS, Haa
7. Mr. Karma Tenzin, Dekiling MSS, Sarpang
8. Mr. Ugyen Tshering, Gauphel LSS, Paro
9. Mr. Chhoegay Dawa, Pangna PS, Dagana
10. Mr. Bhagirath Adhikari, Arekha MSS, Chhukha
11. Mr. Ugyen P Wangchuk, Gelephu MSS, Sarpang
12. Mr. Kinley Wangdi, Drukgyel HSS, Paro
13. Mr. Yeashi Rinzin, Chapcha MSS, Chhukha
14. Mr. Karma Jigme, Dechencholing HSS, Thimphu
15. Mr. Pasang Dorji, Gesarling CS, Dagana
16. Mr. Yeshi Dorji, Jakar HSS, Bumthang
17. Mrs. Kezang Wangmo, Drukgyel HSS, Paro
18. Mr. Yeshi Gyeltshen, Dechencholing HSS, Thimphu

Advisers

1. Mr. Karma Galay, *Director General, DSE, MoE*

Foreword

The world is evolving at an unprecedented pace, driven by technological advancements, data explosion, and knowledge beyond our wildest dreams. Predicting specific skills needed five years from now is daunting, but one thing remains constant: the critical need for mathematical literacy in the workplace and everyday life.

The evolving landscape of mathematical competency goes beyond mere computational efficiency. To be influential contributors on the global stage, nations must cultivate populations proficient in reasoning, problem-solving, data interpretation, and articulating mathematical ideas in a clear and concise manner. Individuals need an intuitive understanding of numbers, their underlying principles, the patterns they form, their real-life applications, and their relationships to other numerical concepts. The ability to transfer learning from one unfamiliar situation to another becomes paramount.

The National School Curriculum represents a shift in education, transitioning from the teaching of 'what' to the learning of 'how' and 'why,' aimed at empowering learners with transversal competencies and 21st-century skills, preparing them to be lifelong learners. In alignment with this initiative, we are optimistic that the paradigm shift in mathematics education will instil a mathematical mindset and disposition, equipping the younger generation with skills that are both rooted nationally and globally competent.

This document outlines a comprehensive framework for desired learning outcomes in mathematics within Bhutanese schools. Its primary purpose is to serve as a foundation for a curriculum and coordinated teaching approaches across all class levels, from PP to 12. The logical and sequential development of mathematical concepts within and across these levels establishes the competencies necessary to foster a mathematically literate society.

Guided by this framework, we are confident in ushering our learners and teachers through a life-enriching journey of experiential Mathematics education.

Tashi Delek

Karma Galay

Director General

DSE, MoESD

Table of Contents

1. Introduction

We are living in a time of extraordinary changes taking place at an amazing rate. Rapid advances in technology, huge increases in the amount of quantitative data, and knowledge beyond our imagination have made it so that we can hardly predict what specific skills will be needed even 5 years from now.

What we do know, however, is that there is, and will continue to be a huge and unprecedented need to understand and use mathematics, in the workplace and in our everyday lives.

More and more, industry is calling for a workforce that is mathematically competent, from the most ordinary of jobs to highly specialised careers. This new mathematical competency requires more than the ability to compute efficiently. To be effective players on the world stage, all nations need a population adept at reasoning, problem solving, dealing with data and communicating mathematical ideas to others in a concise and unambiguous manner. This new generation of mathematically competent citizens must know more about numbers than just how to manipulate them to arrive at an 'answer'. They must have an intuitive sense of those numbers, why they work the way they do, the patterns they form, how they apply to real life problems and their relationships to other numbers. They must become adept at transferring a learning from one situation to another never before encountered.

Those who are able to meet this new standard will have significantly better options than those who don't. A new mathematical competence is quickly becoming the critical filter that will determine who will access those opportunities that lead to satisfying and productive futures, and who will not.

This document provides a comprehensive framework of desired learning through mathematics in the schools in Bhutan. The primary purpose of this framework is to provide a foundation upon which a programme of studies and coordinated teaching learning approaches will be based for each class level from PP to 12. The logical and sequential development of mathematical concepts within and across class levels sets out the competencies necessary to produce a mathematically literate society.

This framework addresses foundational ideas through the gradual construction of

concepts over the years, allowing students time to investigate and assimilate ideas before moving on to more complex ideas.

Mathematics is organised in the form of five content strands namely: Numbers and Operations, Patterns and Algebra, Measurement, Geometry, Data Management and Probability, and a process strand comprising of three parts namely: Formulating situations mathematically, applying mathematical concepts, facts and procedures, and Interpreting, reasoning and evaluating mathematical outcomes. It is aligned with currently accepted practices and standards, as well as, with needs specific to Bhutan.

By engaging in worthwhile and rich mathematical tasks, from class PP through class XII, students would get opportunities to advance mathematical competencies of communication, mathematization, representation, reasoning and argument, strategic thinking and using mathematical (symbolic, formal and technical) language, tools and technology in a higher or lesser degree across all strands.

This framework covers the goals of mathematics education, the key competencies - both at the overall education level and those specific to mathematics, guiding principles for mathematics curriculum development, the structure and organisation of the mathematics curriculum that spells out the content and the process strands, key stage wise competency standards, the competencies for each class for each content strand, the learning objectives, content and essential/process skills. It also spells out the teaching learning process for successful mathematics education, the assessment, cross curricular linkages and finally the enabling conditions that would be required to put in place for effective implementation of the mathematics curriculum.

2. Goals of School Mathematics Education

The goals of mathematics education in Bhutan aim to cultivate learners with a mathematical mindset and essential skills, preparing them to contribute as competent mathematicians, statisticians, and data scientists. The overarching vision for the mathematics curriculum is outlined as follows:

- Empower learners to apply mathematical concepts, fundamentals, and principles in real-world contexts, fostering practical competence in both workplace and daily life.

- Foster the holistic development of learners by nurturing intellectual, social, emotional, physical, and digital competencies, shaping them into socially responsible and productive citizens through experiential learning.

- Enable learners to test, verify, generalise, and create new mathematical knowledge and skills through their experiences in mathematics.

- Foster the engagement of learners in mathematical concepts and processes to develop individuals committed to lifelong learning.

- Equip learners with the mathematical competency needed to thrive in a technologically oriented and information-rich society, whether within Bhutan or globally.

- Demonstrate understanding of mathematical concepts and procedural skills, explore diverse problem-solving strategies, and develop logical reasoning skills for coping with everyday and workplace mathematics.

- Offer a foundational education for students continuing studies in mathematics or other fields requiring a robust mathematical background, while fostering and developing mathematical talent.

- Foster an appreciation of the value and practicality of mathematics, instil confidence in their mathematical abilities, and cultivate an enduring interest in learning and practising mathematics.

3. Key Competencies

Mathematics education at school level in Bhutan is designed to create opportunities for students to develop key competencies that are important in the 21st century. The following seven key competencies namely: spirituality and values, language, transversal competencies, enterprising and industrious, sustainable living, health and wellbeing and digital competence are desired to be achieved at a lesser or higher degree as students complete school education. The following paragraphs briefly describe how mathematics education would facilitate the development of these competencies.

3.1 Spirituality and Values

Inquiry and logical reasoning for rational outlook are at the heart of Mathematics learning. Students can translate these skills to deepen their understanding of spirituality and values in the Bhutanese context. Concepts of solving equations by balancing the left hand side and the right hand side may be used as an analogy to help students understand the balance between the material and spiritual well-being.

3.2 Language

Mathematics promotes logical reasoning. It also has its own vocabulary to name objects and describe actions. These two major ideas can be used in acquisition of any language and also to develop competency in language. Logical reasoning provides students to comprehend language better and structure communication efficiently.

3.3 Transversal Competencies

Using problem-based learning approaches through real world problems as learning experiences in mathematics for constructing and applying knowledge help to foster the development of transversal competencies.

3.4 Enterprising and Industrious

Learning mathematics requires hard work and perseverance. These skills along with critical thinking help individuals to be industrious. Being industrious along with a growth mind set fosters students to be enterprising. Concepts in statistics provide tools in making rightful decisions and being an entrepreneur.

3.5 Sustainable Living

Learning experiences in mathematics that help build and extend students' understanding of the importance of using resources in a sustainable manner broaden the way students see and interact with the world around them. It helps them to realise the interdependence of various resources. Concepts such as estimation, measurement, percentage, analysing data and interpreting statistics are some areas that provide opportunities to apply Mathematics for making decisions related to sustainable living.

3.6 Health and Wellbeing

Learning experiences in mathematics using contexts related to health and well being can help students to understand how to live a healthy life style by making the right choices and knowing the consequences of the choices made. Data management and algebra can help students use data and its trends to understand deeper about health and wellbeing.

3.7 Digital Competence

Use of digital technology, during the teaching and learning of mathematics, in a concerted manner, can improve students' confidence and critical usage of digital technologies for information, communication and basic problem-solving in all aspects of life.

Mathematics and digital technology supplement and complement each other as high digital competence would enable a student to learn mathematics easily while mathematical processes that students go through facilitate critical evaluation of digital technologies, and motivation to participate in the digital culture. A student can advance his/her mathematical skills through coding and by learning mathematics a student can improve his/her coding skills.

At the same time, mathematics education will focus on developing the following six competencies specific to mathematics, namely, communication (that falls under transversal competencies in the NSCF), mathematising, representation, reasoning and argument, devising strategies for problem solving, and using mathematical (symbolic, formal and technical) language, tools and technology.

Mathematical competencies are a set of characteristics or qualities possessed to a greater or lesser extent by a student that underpin each of the three broad mathematical processes (formulating situations mathematically, applying concepts, facts and procedures, and interpreting and reasoning mathematical outcomes).

3.8 Communication

This competency refers to:

- identifying and inferring incoming communication related to reading, decoding, interpreting statements and mathematical information.
- selecting appropriate ways and tools to manage outgoing communication related to explaining, presenting and arguing mathematical results.

Besides the generic competencies stipulated in the National Curriculum Framework, mathematics education focuses on developing the following six competencies specific to mathematics, namely, communication (that falls under transversal competencies in the NSCF), mathematising, representation, reasoning and argument, devising strategies for problem solving, and using mathematical (symbolic, formal and technical) language, tools and technology.

Mathematical competencies are a set of characteristics or qualities possessed by a student that underpin each of the three broad mathematical processes namely, formulating situations mathematically, applying concepts, facts and procedures, and interpreting and reasoning mathematical outcomes.

3.9 Mathematising

This competency refers to:

- transforming a real world problem into a mathematical problem.
- interpreting mathematical objects or information in relation to the context represented.

3.10 Representation

This competency refers to:

- devising or using depictions of mathematical objects or relationships, equations, formulae, graphs, tables, diagrams, textual descriptions to represent problems or results.

3.11 Reasoning and Argument

This competency refers to:

- developing logically rooted thought processes that explore and link problem elements to make inferences from them or to check a given justification or to provide a justification.

3.12 Devising Strategies for Problem Solving

This competency refers to:

- selecting or devising and implementing an appropriate mathematical strategy to solve problems arising from a task or context.

3.13 Using Mathematical Language, Tools and Technology

This competency refers to:

- selecting relevant mathematical symbols and operations while mathematising problems, or representing problems and solutions in mathematical language

- selecting and using relevant mathematical tools including software while formulating, applying or interpreting mathematical solutions.

4. Guiding Principles

The NSCF spells out Science, Technology, Engineering and Mathematics (STEM) as one of the key learning areas. Towards this the mathematics curriculum is developed to support the development of STEM by following the overall guiding principles of curriculum development envisaged in the NSCF.

The following guiding principles provide the philosophical foundation for the development of Mathematics curriculum, modes of delivery, and ways of assessing the learning.

4.1 Values

The curriculum should be founded on the values of Tha Dam Tshig and Ley Jum Drey. This will enable the student to get an in-depth understanding of the Bhutanese culture and the appreciation of its heritage. Through learning meaningful experiences that deal with the understanding of number values, integrity in the mathematical operation and logic applied in mathematical problems foster the values of spirituality, diligence and integrity and interdependency.

4.2 Gross National Happiness (GNH)

The principles of GNH should be deeply embedded in the curriculum for the holistic development of the student. This will prepare the student to participate in and contribute to the culture, society, and economy of the country more meaningfully. Towards this, learning experiences in Mathematics are contextualised to students' real time life experiences and social, economic, and cultural environment. Students are inspired to make meaning of Bhutanese culture and spirituality and values through mathematical perspectives.

4.3 Inclusiveness

The curriculum acknowledges the prevalence of diversity among students in the Mathematics class. In order to ensure that all types of students have access to learning, learning experiences in Mathematics are designed considering the individual differences in terms of gender, cognitive and physical development, family backgrounds and locality. Inclusive education is defined as a process of

addressing the diverse needs of all students by reducing barriers to and within the learning environment. It means accepting different starting points, a different pace of learning and ensuring that students are challenged to achieve high standards in ways that complement what they already know, what they can already do, and how they learn best.

4.4 Future focused, dynamic, and relevant

The curriculum is to guide students to look to the future by exploring significant future-focused issues, such as sustainability, citizenship, enterprise, and globalisation. The curriculum for each learning area ensures that it is responsive to: the ongoing needs of the students and the changing world around them; developments in knowledge; evidence-based practice; and new information about student learning, pedagogy and assessment. Further, the curriculum is relevant to the students' lives both current and future.

The Mathematics curriculum allows students to learn and develop through a variety of contexts, make connections between concepts, people and things related to local, national and global phenomena introduced at developmentally appropriate levels. Every student receives the opportunity to cultivate sustainable learning habits and educational efforts should inculcate personal commitment to enduring habits of lifelong learning and pride in the achievement of excellence.

4.5 Student-centred and developmentally appropriate

The curriculum is student focused. This implies that curricular contents, teaching techniques and assessment methods for each class or level of school education are selected in accordance with children's developmental stages. Each child is different and the rate at which an individual child grows and reaches various developmental stages varies, although the patterns and sequences for growth and development are usually the same for all. Children experience continuous progression in their learning from the age of 2 to 18 years. They progress at a rate which matches their needs and aptitudes. A developmental approach guides their learning, and at the same time allows for assessment of students' progress.

Mathematics curriculum is coherent and focused on important mathematics,

well-articulated across the classes. It encourages student-proposed or teacher-guided contexts to develop connections among areas of mathematical study, as well as connections to other learning disciplines and the real world.

5. Curriculum Structure and Organization

Mathematics is one of the subjects under STEM as per the NSCF. It is offered as a subject from pre- primary to twelve.

Key stage One   : Offered as one subject (Classes PP-III)

Key stage Two   : Offered as one subject (Classes IV-VI)

Key stage Three   : Offered as one subject (Classes VII-VIII)

Key stage Four   : Offered as one subject (Classes IX-X)

Key stage Five   : Differentiated into Pure and Business Mathematics based on (Classes XI - XII) students' aptitude and interest.

Arrangements at the higher secondary level are made to offer mathematics in a differentiated manner into two considering its significance for mathematics literacy and to equip students to pursue higher studies in Mathematics.

The mathematics curriculum focuses on learning of mathematics through five major broad themes as strands namely; numbers and operations, patterns and algebra, measurement, geometry, and data and probability, from pre-primary till class twelve based on the principles of widely accepted developmental theories. The content strands support the development of Mathematical six competencies specific to Mathematics, namely, communication, mathematising, representation, reasoning and argument, devising strategies for problem solving, and using mathematical - symbolic, formal and technical language, tools and technology. The three Mathematical processes of formulating situations mathematically, applying mathematical concepts, facts and procedures, and interpreting, reasoning and evaluating mathematical outcomes serve as the means to deliver Mathematical content strands and develop the related competencies.

The learning in key stage one (Classes PP - III) is based on concrete materials in their immediate surroundings such as home, school and classroom, on the principle of learning through play.

The key stage two focuses on achieving the learning outcomes based on concrete and basic abstract concepts and practices by exploring beyond and through real time experiential learning approach.

The cohorts of learners at key stages three to four possess ability and affinity for logical thinking and abstraction. They have the interest for abstract concepts in problem solving contextualised both at the classroom situation and in the real time environment.

At the key stage five, students are able to look at real world problems, formulate an equivalent mathematical model, solve the problem by selecting and applying appropriate mathematical tools, and interpret the solution in the context of the real world problem.

In the current era, the delivery of Mathematics education is augmented with integration of digital technologies as the means and ends. The significance of technology extends beyond the teaching and learning of Mathematics to accentuating joy and fun of learning Mathematics as personal endeavour.

The school Mathematics curriculum is organised as follows:

5.1 Strands

The learning areas in Mathematics are organised into five content strands and three process strands.

The Content Strands

i.   Numbers and Operations

This strand deals with fundamental understanding of, and proficiency with, counting, numbers, and arithmetic, as well as an understanding of number systems and their structures. The concepts and algorithms of elementary arithmetic are part of number and operations, as are the properties and characteristics of the classes of numbers that form the beginnings of number theory.

Central to this strand is the development of number sense, which is the ability to decompose numbers naturally; use particular numbers like 100 or ½, as referents; use the relationships among arithmetic operations to solve problems; understand the base-ten number system; estimate, make sense of numbers; and recognize the relative and absolute magnitude of numbers.

ii. Patterns and Algebra

This strand emphasises relationships among quantities, including functions, ways of representing mathematical relationships, and the analysis of change. Functional relationships can be expressed by using symbolic notation, which allows complex mathematical ideas to be expressed succinctly and change is analysed efficiently. It also deals with abstract structures and application of principles of those structures in solving problems expressed with symbols.

iii. Geometry

Through this strand, students explore and learn about geometric shapes and structures and analyse their characteristics and relationships. It supports geometric thinking that is characterised by spatial visualisation of building and manipulating mental representations of two dimensional and three-dimensional objects. Students perceive an object from different perspectives. Geometry is a natural place for the development of students' reasoning and justification skills. Geometric modelling and spatial reasoning offer ways to interpret and describe physical environments as important tools in problem solving.

iv. Measurement

Measurement is the assignment of a numerical value to an attribute of an object, such as the length of a pencil. This strand emphasis on understanding what a measurable attribute is and becoming familiar with the units and processes used in measuring attributes. Through this strand students become proficient in using measurement tools, techniques, and formulas in a range of situations. The study of measurement also offers an opportunity for learning and applying other Mathematical functions, including number operations, geometric ideas, statistical concepts, and notions of function. It highlights connections within Mathematics and between Mathematics and areas outside of Mathematics, such as social studies, science, art, and physical education.

v. Data Management and Probability

The amount of data available to help make decisions in everyday life is staggering. This strand engages students to formulate questions that can be answered using data and addresses what is involved in gathering and using the data wisely. Students get opportunities to learn how to collect data, organise their own or others' data, and display the data in graphs and charts, which are useful in making inferences and drawing conclusions from data.

The process strand is called Working Mathematically comprises three Mathematical processes. They are:

  i. Formulating situations mathematically,
 ii. Applying mathematical concepts, facts and procedures, and
iii. Interpreting, reasoning and evaluating mathematical outcomes.

i. Formulating situations mathematically

Formulating situations mathematically refers to the process of converting a real world task or context into the mathematical structure. To do so, a number of cognitive processes need to work together.

Students develop the ability to recall rules and formulae and recognise patterns; use language to understand vocabulary, instructions and explain their thinking; and use sequential ordering to solve multi-step problems and use procedures. Other than this, students learn to use spatial ordering to recognise symbols and deal with geometric forms.

ii. Applying mathematical concepts, facts, and procedures

This process refers to the ability of using mathematical concepts, facts, procedures, and reasoning to solve mathematically-formulated problems in order to obtain mathematical conclusions. In the process, students perform the mathematical procedures required for finding mathematical solutions through arithmetic computations, solving equations, performing symbolic manipulations, extracting

mathematical information from tables and graphs, representing and manipulating shapes in space, and simple analysis of data.

iii. Interpreting, reasoning and evaluating mathematical outcomes

Interpreting refers to the ability of individuals to reflect upon mathematical solutions, results or conclusions and interpret them in the context of the real-life problem that initiated the process. Interpreting involves reasoning with the mathematical solution in the context of the problem, and also evaluating the reasonableness of the solution or processes in the context of the problem. Interpreting, reasoning and evaluating mathematical outcomes encompasses both the 'reasoning' and 'evaluating' elements of the mathematical modelling cycle. Individuals engaged in this process may be called upon to construct and communicate explanations and arguments in the context of the problem, and reflect on both the modelling process and its results.

5.3 Key Stage-wise Competency-based Standards

The Standards are statements of what the public can expect learners to know and be able to do in Mathematics when they graduate from each Key Stage of the school system. The learners are expected to demonstrate a set standard under each of the strands for each Key Stage. The following are the Standards for each Key Stage.

5.4 Class-wise Competencies and Learning Objectives

Competency refers to the learners' ability to solve complex situations by drawing on and mobilising psychosocial resources (including skills and attitudes) in a particular context. The following are the class-wise Competencies for each of the five Strands.

The Learning Objectives will serve as indicators of achievement at each class level in reference to the Competencies and the Standards. These objectives are inter-related and it will not normally be possible or desirable to assess them in isolation. The Learning Objectives encompass knowledge, skills and values for each class level. Teachers should identify additional concepts/topics and essential skills that best fits the teaching and learning activities.

6. Key Stage-wise Competency-based Standards

Key Stage I (Classes PP – III)

Numbers and Operations

1. Develop number sense with respect to whole number, their meanings and multiple representations, place value, and perform meaningful operations in order to deal with numbers in the real world;
2. Select and apply appropriate estimation strategies, to solve problems and to check for reasonableness of answer;
3. Develop a wide variety of relationships with other numbers and across strands so as to support strong reasoning in both mathematical and real life situations;
4. Demonstrate understanding of simple fractions and decimals to tenths, and the relationship between them, so as to provide a strong foundation for higher level fractional ideas and computation.

Patterns and Algebra

1. Recognize and create patterns in mathematical and real world contexts for purposes of solving problems and developing relationships;
2. Apply pattern to problems based on number, geometry and measurement;
3. Use patterns to assist in application of mental maths strategies in response to number operation problems confronted in and outside the classroom.

Measurement

1. Exhibit understanding of the concepts of length, capacity, time, mass and area, and use this understanding to perform measurements using non-standard and standard units;
2. Justify the necessity for common (standard) units as an effective communication tool and also to provide credible evaluation of comparisons;

3. Demonstrate understanding of measurement sense, including a sense of relative size of a unit, so as to effectively determine estimation, measure and check for reasonableness of measurement recorded;
4. Choose appropriate units to effectively solve real life problems in measurement.

Geometry

1. Classify and name geometric shapes according to their attributes and draw relationships among them so as to make sense of the world around them;
2. Draw, model and classify 2-D and 3-D shapes by attributes to foster spatial sense for later ideas in geometry and for real life situations;
3. Predict and verify results of transforming, combining and subdividing shapes to understand other shapes and how shapes change in the world around them;
4. Exhibit development of other aspects of spatial sense including: visual memory, perceptual constancy, visual discrimination and position in space, in order to understand everyday events and objects as well as higher geometrical ideas.

Data Management and Probability

1. Collect, record, organise and describe data to answer one's own designed questions of personal interest or of real world issues and make predictions of the results;
2. Construct picture and bar graphs based on one's own collection of data or a given data, to communicate ideas about the data and check predictions;
3. Interpret data from graphs and tables in a factual way as well as through interpolation and extrapolation (drawing conclusions about things not represented in the data).
4. Express the outcomes of informal investigations of chances, to determine probability of everyday events and to evaluate fairness of a games or real world situation, in order to make effective decisions, using probability language or simple fractions which can facilitate communication of ideas.

Key Stage II (Classes IV – VI)

Numbers and Operations

1. Demonstrate number sense with respect to whole numbers and decimals, and be able to draw on a wide variety of relationships and strategies within number to solve problems in new situations;

2. Represent base ten system to millions and thousandths, and use place value patterns to understand new ideas and apply reasoning to computational problems and mental mathematics within mathematics itself and in real world situations;

3. Apply appropriate estimation strategies, to answer real life questions and check for reasonableness of answer in calculation;

4. Represent fractions and decimals to thousandths, and the relationship between them, and to move freely from one form of representation to another, as might be appropriate in a given situation, and to provide a strong foundation for higher level fractional ideas and computation;

5. Identify meaning and appropriate application of integers, ratios and percent in real world situations;

6. Apply number theory concepts in relevant situations as a way to solve problems with respect to whole numbers, fractions;

7. Model and solve computational problems involving whole numbers and decimals by selecting appropriate operations and procedures for computation, estimation and mental maths;

8. Select appropriate method of computation in given situations (including pencil/paper, mental maths, estimation, technology);

9. Model and solve problems involving the addition and subtraction of simple fractions and be able to justify answers through reasoning;

10. Apply procedures chosen to solve computational problems relevant to the real world and the study of mathematics.

Patterns and Algebra

1. Describe, extend and create patterns to solve problems in real world situations and mathematical contexts (number, geometry, measurement);
2. Use patterns to generalise for mathematical situations to aid in solving problems and understanding relationships;
3. Explore and generalise how a change in one quantity in a relationship affects another, in order to efficiently solve similar (but new) problems;
4. Demonstrate mathematical patterns and relationships in a variety of ways (charts/tables, graphs, numerically) use patterns to assist in mental maths strategies;
5. Solve linear equations via open sentences as a foundation for later algebraic ideas.

Measurement

1. Identify and describe relationships among common SI units and choose appropriate units to solve measurement problems in given situations;
2. Apply common SI units to effectively communicate measurement ideas appropriate to a given measurement situation;
3. Apply variety of strategies to solve measurement problems and understand when estimation is close enough;
4. Interpret relationships and reasoning to develop and apply procedures for measuring in real situations and in mathematical contexts.

Geometry

1. Identify, draw, compare and build physical models of 2-D and 3-D shapes and, focus on their attributes and describe how they affect everyday life;
2. Predict and describe the results of transformation, combine and subdivide shapes to predict other shapes and explain other geometrical ideas;
3. Apply geometric relationships and spatial reasoning to solve problems and explain everyday events and objects, as well as higher geometrical ideas;
4. Exhibit the importance of geometry in understanding mathematical ideas and the world around.

Data Management and Probability

1. Collect, record, organise and describe data in multiple ways to draw conclusions about everyday issues;
2. Identify a variety of ways to display data and choose the most appropriate one;
3. Predict, read, interpret and modify predictions for a variety of data displays, including interpolation and extrapolation (draw conclusions about things not specifically represented by the data);
4. Develop and use measures of central tendency to data reflecting relevant situations, in order to draw conclusions and make decisions;
5. Design and implement strategies for the collection of data, including question design, population sampling, first and second hand data and bias.

Key Stage III (Classes VII – VIII)

Numbers and Operations

1. Develop meanings (number sense) with respect to integers, rational and common irrational numbers and be able to draw on a wide variety of relationships amongst these numbers;
2. Apply strategies to integers, rational and common irrational numbers and their relations to solve problems in relevant situations;
3. Move flexibly from one form of representation of numbers to another, as might be appropriate in a given situation to understand or solve a particular problem;
4. Interpret numbers in many ways, through reading, writing, illustrating, modelling and talking about numbers;
5. Establish relationships between algebraic and arithmetic operations and use this relationship in solving computational problems with algebraic expressions;
6. Model, explain and use rational numbers and integers to solve problems;
7. Model and solve computational problems involving fractions, ratios, percent, proportion, integers, exponents by selecting appropriate operations and procedures for computation, estimation and mental mathematics;

8. Efficiently select and apply appropriate estimation strategies to problems involving rational numbers and integers, to answer real life questions, make predictions and check for reasonableness of answer in calculation.

Patterns and Algebra
1. Represent patterns as algebraic expressions, equations;
2. Interpret patterns through algebraic description and apply generalisations to make predictions of unknown values and solve real world and mathematical problems;
3. Explore and generalise how a change in one quantity in a function affects another, in order to efficiently solve similar problems;
4. Solve linear equations through algebraic methods;
5. Differentiate between linear and nonlinear relations.

Measurement
1. Use concepts of rate to solve real-life mathematical problems;
2. Use direct and indirect measurement to make comparisons and interpret scales;
3. Recognize how a change in one measurement affects another in problems of rate;
4. Convert SI unit from one to another units and vice versa using relations between the units;
5. Choose appropriate units to solve measurement problems in given situations;
6. Estimate effectively using a variety of strategies to solve measurement problems;
7. Apply relationships and reasoning to develop and/or apply procedures for measuring in a wide variety of measurement problems.

Geometry
1. Build and analyse physical and pictorial models of 2-D and 3-D shapes to understand relationships and properties, and enhance spatial sense in

mathematical and real-world situations;

2. Analyse the results of transforming shapes to understand and apply transformation properties to mathematical and real-world situations and to explain geometrical ideas;

3. Compare, classify and apply geometric properties to figures;

4. Appreciate the importance of geometry in understanding mathematical ideas, in art, and in the world around them.

Data Management and Probability

1. Collect, organise and interpret data;

2. Explore, interpret and make predictions for everyday events by estimating and conducting experiments;

3. Determine theoretical and experimental probability, understand the difference between the two and determine when each is relevant to a particular situation;

4. Express probability as ratios, fractions, decimals, percent and choose appropriate expressions given a particular situation;

5. Conduct simulations and experiments to determine the probability of single and complementary events in real life situations;

6. Use real life data to establish broad probability patterns for the purpose of planning and making decisions (e.g., patterns in population growth, traffic).

Key Stage IV (Classes IX – X)

Numbers and Operations

1. Demonstrate an understanding of the real number system and its subsystems by applying a variety of number theory concepts in relevant situations;

2. Demonstrate understanding of sets through their representations and operations to apply in sorting of data in real life;

3. Evaluate properties of matrices and networks through their representations and operations to apply to real life situations;

4. Use ideas of calculating income, expenditure, taxation and interests to plan one's budget and evaluate interests as a way of saving money;

5. Solve situational problems on buying and selling, simple and compound interests, dividends and stocks to evaluate better purchasing decisions.

Patterns and Algebra

1. Model real world problems using functions, equations, inequalities, and discrete structure;
2. Represent functional relationships in multiple ways and describe connections among those representations;
3. Solve problems involving relationships, using graphing technology as well as paper and pencil techniques;
4. Perform operations on and between functions;
5. Analyse and explain the behaviours, transformations, and general properties of types of equations and relations;
6. Interpret algebraic equations and inequalities geometrically and geometric relationships algebraically.

Measurement

1. Apply properties of 2-D and 3-D efficiency in real life contexts;
2. Measure quantities indirectly, using techniques of algebra, geometry and trigonometry;
3. Determine measurements in a wide variety of problem situations, and determine specified degrees of precision, accuracy, and error of measurement;
4. Apply measure formulas and procedures in a wide variety of contexts.

Geometry

1. Make and test conjectures about, and deduce properties of and relationships between, 2-D and 3-D figures in multiple contexts;
2. Interpret and classify geometric figures, translate between synthetic and coordinate representations, and apply geometric properties and relationships;
3. Analyse and apply Euclidean transformations, including representing and applying translations, reflections, rotations and dilations;
4. Represent problem situations with geometric models and apply properties of

figures;

5. Demonstrate an understanding of the operations of axiomatic systems, and the connections among reasoning, justification and proof.

Data Management and Probability

1. Apply appropriate methods of data representation for a set of real life based data (both grouped and ungrouped) collected to evaluate the data distributions and draw conclusions;
2. Use line and curve of best fit to determine the relationships between the variables and make predictions from the set of data;
3. Predict, read and draw inferences for a variety of data display and identify the features of misleading graphs;
4. Represent and solve problems involving uncertainty;
5. Determine theoretical probability for dependent and independent events and apply to real life situations.

Key Stage V (Classes XI – XII: Business Mathematics)

Numbers and Operations

1. Demonstrate an understanding of matrices and determinants, and apply in solving real-life problems involving systems of equations;

2. Exhibit an ability to show the relationship between logarithmic and exponential expressions, and apply the properties and laws of logarithm in solving problems.

3. Display an ability to employ binomial theorems in expanding expressions with positive indices;

4. Demonstrate an understanding of annuities and discounts, and apply in trade, business, insurance and banking;

5. Demonstrate an understanding of the Bill of Exchange, and apply in trade, business, commerce and economics.

6. Demonstrate an ability to solve problems involving permutations and combinations, and utilise them in determining probabilities and solve real-life problems;

7. Exhibit an understanding of different types of bank accounts in Bhutanese banks and calculate interests on saving and fixed deposit accounts.

Patterns and Algebra

1. Demonstrate an understanding of Arithmetic and Geometric Progression to apply in solving real-life problems;

2. Exhibit an ability to factor cubic polynomials using remainder and factor theorem to solve real-life problems involving polynomial equations;

3. Demonstrate an ability to solve any quadratic equations and inequalities, and interpret their roots to utilise in solving real-life problems;

4. Demonstrate an ability to use the fundamental theorem of limits in differentiation and other relevant situations;

5. Display an understanding of differentiation and integration theoretically as well as geometrically, and apply the knowledge in real-life situations wherever appropriate;

6. Demonstrate an ability to perform high order differentiation of some functions using various strategies;

7. Exhibit an ability to perform integration of some functions using various strategies.

Measurement and Geometry

1. Demonstrate an ability to write the equations of straight lines in different forms and apply the concepts in solving problems related to commerce and economics;

2. Demonstrate an understanding of 2-D and 3-D coordinate systems, and describe a location of an object in 2-D plane and 3-D space;

3. Display the skills to apply distance formula, section formula and midpoint formula in solving relevant problems;

4. Demonstrate an understanding of the equation of circle in standard form and solve related problems;

5. Exhibit the knowledge of circle theorems and utilise them in solving logical problems related to circles;

6. Demonstrate an understanding of the meaning of conic sections, find their parts, and apply the concepts in real life situations.

Data Management and Probability

1. Demonstrate an ability to describe and interpret data distributions by determining central tendencies, deviations, and correlation coefficients;

2. Exhibit skills to apply regression equations in forecasting, optimization and predictions in business and other real-life situations;

3. Demonstrate an ability to determine probabilities by applying concepts of laws or probabilities, permutations and combinations, and conditional probability.

Key Stage V (Classes XI – XII: Mathematics (PMT))

Numbers and Operations

1. Demonstrate an understanding of numbers with respect to real numbers and complex numbers;

2. Apply concepts of determinant and matrix in determining solution of system of linear equations derived from real world problems;

3. Apply the theorems and laws of exponents and logarithm in higher applications of mathematics;

4. Exhibit the ability to use the fundamental principles of counting or formulas of P(n,r) and C(n,r) to find number of permutations and combinations in real life problems;

5. Apply the concept of binomial theorem in expansion of binomial expression with integral powers.

Patterns and Algebra

1. Display an understanding of patterns of numbers in concepts of arithmetic and geometric progression;

2. Apply the knowledge of remainder and factor theorems, quadratic equations and partial fractions in relevant situations under different fields;

3. Model real world problems using functions;

4. Employ the concepts of functions, domain, range and limits in scaffolding the definitions of differentiation and integration;

5. Apply the rules of derivatives and higher derivatives in optimization problems in real life situations;

6. Demonstrate an understanding of integral in indefinite and definite form to evaluate areas and volumes of regular and irregular shapes in immediate environment;

7. Employ effective methods to evaluate general and particular solutions of each kind of differential equation.

Measurement

1. Derive and apply the compound and multiple angles formula in solving problems;

2. Utilise the properties of inverse trigonometric functions in higher applications of mathematics.

Geometry

1. Demonstrate an understanding of a point and a line segment in a two-dimensional and three-dimensional coordinate system;

2. Calculate the distance and angle between two lines employing relevant formulas and methods;

3. Describe the parallelism and perpendicularity of two lines by analysing their slopes, angle, direction cosines or direction ratios;

4. Implement the concepts of equation and theorems of circle in solution of problems in relevant real life applications;

5. Visualise and illustrate different conics through the use of interactive tools and describe the equation and components of each conic;

6. Exercise the conditions for a general second-degree equation to represent a pair of straight lines;

7. Generate the equations of planes under different conditions;

8. Exemplify and calculate the distance and angle between two plane surfaces in real world space.

Data Management and Probability

1. Measure the central tendencies and dispersions of different data distributions collected through real world experiments;

2. Study and interpret the degree of dependence of two variables in an ungrouped data to examine trends and make estimates or forecasts;

3. Determine the probabilities of random real-world events through application of laws of probability;

4. Apply statistics and probability concepts in real life situations for wiser decision-making.

7. Class-wise Competencies, Learning Objectives, Content and Essential Skills/Processes.

Class PP

Strand A: Numbers and Operations

Competencies for Class PP

1. Demonstrate the ability to identify different attributes of objects and apply the concepts to describe objects in the real world.

2. Identify the attributes of objects and sort objects based on the various sorting rules in familiar and new situations.

3. Compare sets using appropriate terms and apply the skill to describe comparison of quantities in real life situations.

4. Apply the concept of counting till 100 in sequence to describe quantity in the environment and develop number sense.

5. Represent and identify numbers till 30 concretely, pictorially, symbolically, and apply the skill to deal with quantity and numbers in real life.

6. Demonstrate the ability to write numbers to 30 and express quantity symbolically in real life.

7. Demonstrate the ability to interpret the meaning of addition, using concrete and pictorial models and solving simple addition problems.

8. Interpret the meaning of subtraction as 'taking away', using concrete and pictorial models, and solve simple real life problems.

9. Apply the concept of ordinal numbers (till 10th) to identify and express the position of objects in the real environment.

Learning Objectives	Content	Essential Skills/Processes
● Identify different attributes of objects.	PP-A1 Describing Attributes of Objects	● Observing ● Examining ● Identifying

● Describe objects based on colour and material. ● Describe objects based on shape, size and texture.		● Describing ● Communicating
● Sort objects into different sets based on sorting rules, using actual objects and pictures in familiar and in new situations. ● Distinguish between objects that belong to/do not belong to a given set. ● Differentiate between sets that have/do not have a given number of items.	PP-A2 Sets	● Sorting ● Identifying ● Analysing ● Estimating ● Comparing ● Inferring
● Compare sets using appropriate terms and apply the skill to describe comparison of quantities in real life situations.	PP-A3 Comparing Sets	● Sorting ● Identifying ● Analysing ● Estimating ● Comparing ● Inferring
● Count in the correct sequence using concrete objects. ● Identify that the order in which objects are counted, doesn't change the amount. ● Recognize that the last number said is the count, using concrete objects. ● Recognize simple amounts without counting till 10. ● Count to 30 as '1 and 1 more is 2', '2 and 1 more is 3', etc. using concrete objects. ● Chant numbers till 100 in the correct sequence.	PP-A4 Counting Numbers till 100	● Observing ● Counting ● Recognizing ● Sequencing ● Subitizing ● Relating ● Communicating

● Represent numbers till 30 concretely and pictorially. ● Identify symbolic representation of numbers till 30.	PP-A5 Representing Numerals till 30	● Representing ● Identifying ● Connecting ● Communicating
● Form numerals by tracing in the air, on sand or on modelling clay ● Write numerals on paper by tracing and self-writing in sequence ● Represent numbers in a set symbolically.	PP-A6 Writing Numerals till 30	● Identifying ● Matching ● Tracing ● Writing ● Communicating
● Explain 'addition' as putting together by combining sets of concrete objects, with the sum till 10. ● Estimate sums before adding. ● Relate addition to increase in quantity. ● Recognize that addition involves finding out 'how many are there altogether' in a set.	PP-A7 Addition	● Examining ● Recognizing ● Relating ● Inferring ● Communicating
● Relate subtraction to decrease in quantity while taking away objects from a given set. ● Estimate the difference before carrying out subtraction. ● Compare two sets to find how many more items need to be added to the smaller set to make it equal to the bigger set.	PP-A8 Subtraction	● Estimating ● Inferring ● Recognizing ● Comparing ● Communicating
● Describe the position of objects from 1st to 10th. ● Identify ordinal numbers from 1st to 10th as symbols. ● Read ordinal numbers from 1st to 10th.	PP-A9 Ordinal Numbers till 10th	● Recognizing ● Sequencing ● Relating ● Communicating

Learning Objectives	Content	Process/ Essential Skills
● Continue sequence of ordinal numbers from different starting places. ● Write ordinal numbers from 1st till 10th appropriately in correct sequence.		

Strand B: Patterns and Algebra

Competencies for Class PP

1. Identify repeating patterns in their environment and predict what follows in simple real life situations.

2. Interpret and create repeating patterns in various ways and apply the concept to solve simple real life problems.

Learning Objectives	Content	Process/ Essential Skills
● Examine simple repeating patterns in their immediate environment. ● Identify repeating patterns with concrete objects based on size, colour and shape. ● Examine sound and action-based patterns that repeat and predict the sound/action that would follow.	PP-B1 Repeating patterns	● Exploring ● Examining ● Recognizing ● Connecting ● Applying ● Communicating
● Represent repeating patterns in different ways (e.g., a snap, clap, snap, clap, snap, clap pattern could be represented by a blue, red, blue, red, blue red pattern or by a 1, 2, 1, 2, 1,2 pattern)	PP-B2 Representing Patterns Concretely	● Identifying ● Interpreting ● Exploring ● Analysing ● Representing ● Modelling ● Communicating

Learning Objectives	Content	Process/ Essential Skills
● Read repeating patterns in different ways (e.g., ABC pattern can be read as 1 2 3) ● Create their own pattern using the concept of a repeating pattern.		

Strand C: Measurement

Competencies for Class PP

1. Compare length directly and indirectly using appropriate terms and justify the use of indirect comparison in real life, in simple language.

2. Demonstrate the ability to compare capacity of containers used in their daily life directly and indirectly, using appropriate terms.

3. Demonstrate the ability to compare mass and describe objects as heavier/lighter objects in the environment.

Learning Objectives	Content	Process/ Essential Skills
● Sort different objects based on their length as short or long objects. ● Compare lengths directly using the terms 'longer than' and 'shorter than'. ● Explain the importance of aligning endpoints to compare lengths. ● Compare lengths indirectly and describe lengths of objects as 'longer /shorter than', or 'of the same length' in relation to the third object. ● Order three different lengths using indirect comparison. ● Explain the use of indirect comparison in real life, in simple language.	PP- C1 Comparing Length Directly and Indirectly	● Sorting ● Predicting ● Comparing ● Problem solving ● Ordering ● Communicating

- Compare capacity of different containers directly. - Describe comparison of capacity using the phrases 'holds more', 'holds less' and 'holds the same'. - Compare capacity of containers indirectly (using a third container) and describe comparison using appropriate phrase.	PP-C2 Comparing Capacity Directly and Indirectly	- Describing - Predicting - Comparing - Problem solving - Communicating
- Compare mass directly (with no units) by hand or using pan balance. - Compare mass indirectly, using the mass of a third object. - Describe comparison of mass using terms like 'heavier/lighter than'/ 'about the same' - Discuss the common misconceptions such as: - objects of same mass but of different size - objects of same size but of different mass - objects which are large but light - objects which are small but heavy - Sort different objects according to their mass.	PP-C3 Comparing Mass Directly and Indirectly	- Describing - Predicting - Comparing - Sorting - Problem solving - Communicating

Strand D: Geometry

Competencies for Class PP

1. Examine the position of an object in real life and describe them in relation to the position of another object and the observer.
2. Explain the attributes of given 3-D and 2-D shapes and classify them as 3-D or 2-D shapes, to recognize shapes in their immediate surroundings.

3. Identify examples of 3-D and 2-D shapes in the environment.
4. State names of learnt 3-D and 2-D shapes.
5. Identify shapes inside other shapes in the environment.

Learning Objectives	Content	Process/ Essential Skills
- Describe position in space, including the relative position of: - o one object to another, - o the object to the observer. - Explain positions using terms like 'beside', 'above', 'below', 'between', 'in front of', 'through', 'behind', etc. - Connect perception to action (experiential) where the child moves.	PP-D1 Spatial Sense: Position in Space	- Exploring - Observing - Relating - Describing - Explaining - Connecting - Communicating
- Identify and discuss attributes of 3-D and 2-D shapes to compare and sort the shapes in different ways, through hands-on experiences. - Use shape names (not memorise) such as triangle, circle, rectangle, cylinder, cone, sphere, rectangular prism. Examine how shapes can be transformed into other shapes by building various shapes and structures, focusing on the attributes. - Distinguish 3-D and 2-D shapes by exploring non-examples in their surroundings. - Explore perceptual constancy concept (a shape can be moved by	PP-D2 3-D and 2-D Shapes	- Examining - Describing - Distinguishing - Classifying - Modelling - Communicating

Learning Objectives	Content	Process/ Essential Skills
sliding, flipping or turning, and still be exactly the same shape).		
● Identify examples of 3-D and 2-D shapes in the environment. ● State names of learnt 3-D and 2-D shapes. ● Identify shapes inside other shapes in the environment.	PP-D3 3-D & 2-D shapes in real life	● Identifying ● Recognizing ● Relating ● Communicating

Strand E: Data Management and Probability

Competencies for Class PP

1. Collect, organise and interpret data using pictures and charts and answer simple questions related to real life situations.
2. Examine concrete graphs involving real objects and people to Interpret information presented through concrete graphs.

Learning Objectives	Content	Process/ Essential Skills
● Respond to questions of interest (weather, favourite snack, more boys or girls, etc.) ● Perform Simple experiments and record the responses. ● Establish and organise the collected data pictorially (using pictures, or charts) ● Predict results and discuss the finding of the collected data.	PP-E1 Collect and Organise Data and Interpret Data (Pictorially, in Chart Form)	● Questioning ● Responding ● Recording ● Organizing ● Examining ● Analysing ● Interpreting ● Communicating
● Study concrete graphs using real objects and people. ● Exhibit the understanding of the importance of common start line. ● Describe data focusing on one-to-one correspondence.	PP-E2 Concrete Graphs: (Actual Objects and People Graphs)	● Organizing ● Predicting ● Examining ● Describing ● Comparing ● Analysing ● Interpreting ● Modelling

● Discuss interpretation of the formed graphs and its application.		● Communicating

Class I

Strand A: Numbers and Operations

Competencies for Class I

1. Demonstrate the ability to use familiar vocabulary to compare quantities in real life.

2. Apply the concept of counting till 100 in sequence to describe quantity in real life situations and develop the number sense.

3.   Recognize the number arrangement patterns and use the concept to chant numbers beyond 100 till 500 from any starting point in the correct sequence.

4. Represent and identify numbers to 100 using concrete objects, ten frames, and symbols, and use it in their daily life.

5. Read and write ordinal numbers (1st-20th) and apply the concept to describe sequence in real life situations.

6. Demonstrate the ability to estimate the amounts till 20 using different strategies and effectively estimate fewer quantities encountered in their daily life.

7. Apply the idea of counting on and backward by 2s, 5s, and 10s, and count large quantities effectively in real life situations.

8. Demonstrate the ability to apply the concept of place value of 2-digit numbers to identify and represent 2-digit numbers accurately.

9. Exhibit the skill of comparing 2-digit numbers using benchmarks to recognize the value of a number and its relation to other numbers.

10. Exhibit understanding of a whole and its part called fraction and apply the concept in real life situations to describe halves as parts.

11. Express the meaning of addition using models, diagrams, and symbols and effectively apply the concept to find the sum up to 20.

12. Express the meaning of subtraction using models, charts, and symbols, and effectively apply the concept to find the differences between numbers.

13. Relate addition and subtraction facts using the model and apply the concept to solve real life problems involving addition and subtraction effectively.

14. Apply identified patterns to solve addition and subtraction and apply the pattern learnt in real-life situations.

15. Apply various strategies to mentally calculate sums and differences till 10 and solve simple problems in real life effectively.

Learning Objectives	Content	Process/ Essential Skills
● Estimate to compare the sets that total up to 20, using terms such as 'more', 'fewer', 'the same' (orally). ● Compare quantities by using words such as 'more', 'fewer', or 'the same' in sets (using concrete objects). ● Create sets where the number of items is made equal or added or taken away to use the words 'more', 'fewer', 'the same'. ● Use appropriate words to describe the comparison of sets found in their daily life.	I-A1 Compare Sets	● Sorting ● Identifying ● Analysing ● Estimating ● Comparing ● Inferring ● Communicating
● Explaining the counting order doesn't change the amount. ● Count in the correct sequence and recognize that the last number said is the count, using the concrete objects from the environment and singing counting rhymes. ● Recognise and count numbers till 100 in correct sequence. ● Chant numbers till 500 from any starting point in the correct sequence.	I-A2 Counting Numbers till 500	● Chanting ● Counting ● Sequencing ● Communicating ● Collaboration ● Analysing ● Decision Making ● Problem solving ● Adaptability
● Students can chant numbers to 100 in sequence. ● Represent numbers to 100 using concrete objects (counters, snap cubes, base- ten blocks, fingers in teams and ten frames)	I-A3 Representing Numbers Concretely till 100	● Representing ● Chanting ● Counting ● Sequencing ● Communicating

● Identify and write numerals in symbols and words till 100. ● Explain some situations where we count in our day-to-day life.		
● Read ordinal numbers till the 20th. ● Describe the position in the correct sequence, using ordinal numbers from 1st till 20th. ● Connect to real-life situations, stories, actions (situational, not symbolic) ● Write ordinal numbers from given samples (1st till 20th) ● Relate ordinal numbers in words to symbols (1st – First).	I -A4 Ordinal Numbers: Recognizing ordinal numbers from 1st till 20th Sequencing real-life events	● Representing ● Chanting ● Sequencing ● Relating ● Writing ● Communicating
● Estimate simple amounts till 20. ● Develop estimation strategies such as chunking and using referents. ● Relate estimation to real-life situations.	I-A5 Estimating Amounts to 20	● Estimating ● Relating ● Comparing ● Analysing ● Communicating
● Count by 2s, 5s, and 10s using various ways. ● Count on or backward from a given number (up to a range of 20).	I-A6 Counting 2-digit number	● Counting ● Sequencing ● Relating ● Communicating
● Model whole numbers to 2 places by grouping tens and ones. ● Distinguish between the place value of Tens and Ones. ● Explain how digit placement denotes the value of each digit of a number. ● Demonstrate the understanding of placement by using group-able to pre-grouped models of base ten blocks to: o Identify a 2-digit number given in a place value chart.	I-A7 Place Value (2-digit numbers): Identifying the value of digit placement Using base ten block models	● Comprehending ● Representing ● Examining ● Analysing ● Relating ● Communicating

● Represent a 2-digit number in in a place value chart by identifying tens and ones correctly		

● Compare numbers using benchmark numbers.
● Make use of 'more than', 'less than' or 'is the same as' to describe comparison.
● Differentiate 2-digit whole numbers with:
  o different tens
  o an equal number of tens
	I-A8 Comparing 2-digit whole numbers	● Representing
		● Comparing
		● Analysing
		● Relating
		● Communicating

● Identify half as equal sets or equal parts. ● Represent halves using concrete objects in various ways. ● Discuss the use of fractions in real life experiences.	I-A9 Fractional Parts: Equal shares, Partitioning, one by one. Exploring 'Halves'	● Representing ● Relating ● Comparing ● Analysing ● Communicating
● Explain the meaning of addition as putting together by using concrete materials. ● Draw inference that altering addends does not change the sum. ● Apply different strategies to add sums to 20. ● Use models, diagrams, and symbols to represent addition situations	I-A10 Addition: Developing the meaning of addition. Recognizing the commutative property. Exploring strategies for finding sums till 20. Recording Addition.	● Representing ● Relating ● Examining ● Inferring ● Comparing ● Adding ● Recording ● Communicating
● Relate the meaning of subtraction as taking away or separating while exploring.	I-A11 Subtraction	● Representing/ modelling ● Counting

• Use concrete materials to take away objects physically to :
   o count the remainder
   o count backwards from the total
• Compare two sets to find how many more items need to be added to the smaller set to make it equal to the bigger set.
• Identify real life situations where subtraction is used.
• Record subtraction facts correctly.
		• Relating
		• Comparing
		• Recording
		• Communicating

• Model situations to represent addition and subtraction facts.
• Infer that addition and subtraction "undo" each other.
• Use the concept of addition and subtraction facts in situations where:
   o the result is unknown
   o the addend/subtrahend is unknown
	I-A12 Addition and Subtraction Facts: Exploring the relation between Addition and Subtraction. Representing Addition and Subtraction Facts.	• Representing
		• Modelling
		• Examining
		• Relating
		• Analysing
		• Communicating

• Apply various strategies to calculate sums and differences mentally. • Choose an appropriate strategy to solve addition and subtraction problems mentally related to our real life situations.	I-A13 Mental Strategies: Sums & Differences to 10	• Observing • Applying • Analysing • Decision making • Reasoning • Communicating

Strand B: Patterns and Algebra

Competencies for Class I

1. Identify repeating and growing patterns in the environment and apply the concept of patterns in real life situations.

2. Apply identified patterns to solve addition and subtraction problems effectively.

3. Examine place value patterns and explain the connection between numbers and place value models.

Learning Objectives	Content	Process/ Essential Skills
- Identify repeating and growing patterns focusing on attributes of shapes. - Extend repeating and growing patterns. - Represent repeating with numerals and growing patterns with numbers after counting the items. - Create repeating and growing patterns in various ways.	I-B1 Copy, Extend, Create Patterns	- Exploring - Examining - Analyzing - Identifying - Creating - Relating - Describing - Communicating
- Identify and use patterns in Addition or Subtraction facts - Explore and show the patterns found in the hundred charts.	I-B2 Using patterns to solve Addition & Subtraction	- Exploring - Examining - Analyzing - Identifying - Communicating
Connect numbers to place value models concretely (e.g. what happens to the numeral when 10 is consistently added or taken away?)	I-B3 Place Value Patterns	- Comprehending - Analysing - Relating - Communicating

Strand C: Measurement

Competencies for Class I

1. Demonstrate the understanding of measurement through the application of different principles of measurement
2. Demonstrate the ability to measure length and distance using non-standard units to describe length in real life situations.
3. Demonstrate the ability to use non-standard units of measurement to estimate and measure the capacity of common containers effectively.
4. Demonstrate the ability to compare mass directly and indirectly to apply in day to day life using the concept and principles of measurement of mass.
5. Exhibit the understanding of area as surface space to estimate the space required for objects in the real world.
6. Apply the concept of time value in daily life by reading the time on analog and digital clocks in hours.

Learning Objectives	Content	Process/ Essential Skills
• Explore measurement through hands-on experiences. • Explain the importance of common starting points for measuring lengths using simple language. • Explain how the use of bigger units results in smaller counts and vice versa.	I-C1 Measurement: Concept and Principles	• Predicting • Observing • Analyzing • Decision Making • Investigating • Socializing • Communicating
• Measure length using objects as non-standard units. • Measure lengths using body parts as non-standard units. • Justify the choice of a non-standard unit to measure length.	I I-C2 Measuring Length using Non-Standard Units	• Observing • Analyzing • Decision Making • Investigating • Socializing • Communicating
• Estimate the capacity of a container in relation to smaller containers.	I-C3 Measuring Capacity using	• Predicting • Observing • Comparing

• Measure capacity of containers using non-standard units.	Non-Standard Units	• Analyzing • Estimating • Creating • Communicating
• Estimate mass of an object in relation to the mass of smaller objects. • Measure mass of objects using non-standard units.	I-C4- Comparing Mass (no units)	• Identifying • Analysing • Estimating • Comparing • Inferring • Justifying • Communicating
• Explain the meaning of area as 'surface space'/the amount of surface covered. • Compare area directly (no units) • Measure area using concrete objects (non-standard units) • Exhibit the understanding that bigger unit result in smaller counts and vice versa.	I-C5 Area	• Observing • Defining • Comparing • Analysing • Decision making • Communicating
• Compare time directly (no units) by comparing the duration for various tasks. • Express time in 'hour' on analog and digital clocks. • Create plans / schedules for daily activities using hours.	I-C6 Time: Compare Time Duration Reading Time by Hours	• Observing • Comparing • Analyzing • Modelling/ Representing • Decision making • Planning • Communicating

Strand D: Geometry

Competencies for Class I

1. Exhibit development of visual memory by recalling objects or drawings and apply spatial sense of shapes and space to the real world.
2. Distinguish 2-D shapes from 3-D shapes and interpret constructions of various objects in the real world.
3. Demonstrate the ability to identify 2-D faces on 3-D shapes and recognize how three dimensional objects are built from flat shapes.

4. Identify 3-D and 2-D shapes in the environment and consider how a shape/structure is suitable for its purpose.
5. Combine and subdivide shapes to form new shapes and recognize how objects/structures are built or formed in the environment.
6. Demonstrate the ability to recognize symmetry and create different types of symmetrical shapes in relation to nature and the real life applications.

Learning Objectives	Content	Process/ Essential Skills
● Create visual memory by recalling objects or drawings which are no longer in view. ● Recognize figures against a complex background. ● Assemble parts to make a whole.	I-D1- Spatial Sense: Visual Memory; Figure-Ground Perception	● Observing ● Recalling ● Assembling ● Creating
● Identify and discuss the attributes of 3-D ● Identify and describe the attributes of 2-D shapes ● Recognize and name shapes: rhombus, trapezoid, hexagon, cylinder, sphere, cone and cube ● Explain similarities and differences among shapes.	I-D2 3-D & 2-D Shapes	● Observing ● Identifying ● Examine ● Compare ● Analyzing ● Drawing ● Communicating
● Identify and discuss the attributes of 3-D ● Identify and describe the attributes of 2-D shapes ● Recognize and name shapes: rhombus, trapezoid, hexagon, cylinder, sphere, cone and cube ● Explain similarities and differences among shapes.	I-D2 3-D & 2-D Shapes	● Observing ● Identifying ● Examine ● Compare ● Analyzing ● Drawing ● Communicating
● Identify similar faces in different solids. ● Distinguish 3-D shapes by 2-D faces.	I-D3 2-D figures on 3-D Shapes	● Observing ● Examining ● Identifying ● Drawing ● Analyzing

		● Communicating
● Identify 3-D and 2-D shapes in the environment of various sizes and proportions. ● Model the 3-D shapes spotted in the environment. ● Recognize how a shape is suitable for its purpose of its structure.	I-D4 2-D & 3-D Shapes in the Environment	● Observing ● Examining ● Identifying ● Analyzing ● Modelling ● Communicating
● Combine shapes to compose new shapes with the provided shapes. ● Examine the resulting new shapes formed when shapes are subdivided. ● Recognize combination of shapes in the environment.	I-D5 2-D Shapes: Combine shapes Subdividing shapes	● Examining ● Analysing ● Composing ● Comparing ● Modelling ● Communicating
● Recognize symmetrical shapes ● Create symmetrical shapes ● Identify the use of reflective symmetry in the real world.	I-D6 2-D Reflective Symmetry	● Predicting ● Examining ● Describing ● Observation ● Modelling ● Communicating.

Strand E: Data Management and Probability

Competencies for Class I

1. Demonstrate the ability to collect data by designing simple questions and recording responses to collect information in real life.
2. Demonstrate the ability to create concrete graphs and interpret pictographs to present and understand information in real life.
3. Use probability language to describe the occurrence of simple future events, appropriately and apply the concept of probability to make appropriate decisions.

Learning Objectives	Content	Process/ Essential Skills
- Design simple questions requiring yes or no responses (orally) to collect data. - Record responses (collecting data) appropriately. - Use tallies to organise and present the collected data.	I-E1 Collecting Data	- Predicting - Observing - Questioning - Interviewing - Note taking - Recording - Organizing - Examining - Analyzing - Interpreting - Communication
- Create concrete graphs with representative objects while paying attention to: - Common base line. - One-to-one correspondence. - Examine pictograph and Interpret information presented by a pictograph.	I-E2 Graphs: Creating Concrete Graphs Interpreting Picture Graphs	- Examining - Comparing - Analyzing - Interpreting - Representing - Modeling - Communicating
- Predict the occurrence of simple future events. - Describe occurrence of future events using the terms 'impossible', 'possible', or 'certain'. - Identify and describe different situations where we can use probability language. - Make appropriate decisions according to predictions of future events.	I-E3 Probability of Everyday Events	- Observing - Predicting - Analyzing - Describing - Planning - Decision making - Reasoning

Class II

Strand A: Numbers and Operations

Competencies for Class II

1. Count numbers from 100 to 999 in various ways and apply the skill to count large quantities effectively.

2. Interpret information delivered by calendar and read dates as ordinal numbers, appropriately.

3. Justify the estimate of counts till 100 and apply it to describe quantities in simple real life situations.

4. Read and represent 3-digit numbers concretely, pictorially and symbolically.

5. Explain and use different methods to compare 3-digit whole numbers to express the value of numbers in comparison to other numbers.

6. Calculate change by investigating relations among currency notes (till Nu. 500) in our everyday life.

7. Interpret and model simple fractions in various ways and relate to real life representations of fractions.

8. Explore addition properties to solve and record simple addition problems, concretely, pictorially and symbolically.

9. Estimate sums (till 100) to check the reasonableness of the answers to addition problems solved using various methods.

10. Apply various strategies to solve subtraction problems and use estimation to check the reasonableness of the answers obtained.

11. Relate addition and subtraction to calculate mentally (till 20) and use it in real life situations.

Learning Objectives	Content	Process/ Essential Skills
● Count numbers till 999 by counting in various ways.	II-A1 Counting Beyond 100: Counting on and Backward	● Counting ● Sequencing ● Analysing

● Count numbers till 999 backward in various ways.		● Relating ● Communicating
● Read and write ordinal numbers from 1st till 31st. ● Use ordinal numbers to read dates in the calendar. ● Interpret the days from the calendar.	II-A2 Relating Ordinal Numbers to Calendar	● Observing ● Examining ● Analysing ● Relating ● Communicating
● Estimate counts till 100 by applying estimation strategies such as chunking and using referents. ● Apply estimation to solve real life problems.	II-A3 Estimating Numbers till 100	● Observing ● Estimating ● Relating ● Communicating
● Model and interpret 3-digit numbers concretely (using base ten blocks), pictorially (using place value charts) and symbolically.	II-A4 Represent 3-Digit Whole Numbers: Using Base-Ten Blocks Using Place Value Charts	● Modelling ● Representing ● Examining ● Analysing ● Interpreting ● Reasoning ● Communicating
● Compare 3-digit whole numbers and explain the method used for comparing the numbers. ● State comparison of numbers orally and symbolically.	II-A5 Comparing 3-Digit Whole Numbers	● Representing ● Comparing ● Analysing ● Recording ● Communicating
● Examine and explain the relationship among currency notes (till Nu 500). ● Calculate change by carrying out trading activities.	II-A6 Money	● Examining ● Representing ● Relating ● Inferring ● Calculating ● Making connection ● Communicating
● Identify and read fractions (Halves, Thirds and Fourths) correctly.	II-A7 Simple Fractions:	● Identifying ● Representing

● Model fractions, (Halves, Thirds and Fourths), concretely, pictorially, and symbolically, as part of a whole and part of a set. ● Explore and discuss representations of fractions in real life.	Modelling Numerators and Denominators	● Relating ● Making connections ● Communicating
● Solve simple addition problems by applying the properties of addition. ● Carry out addition concretely (using base ten blocks), pictorially and symbolically. ● Relate the use of addition and its properties to real life situations.	II-A8 Properties of Addition: Commutative Associative	● Examining ● Identifying ● Relating ● Analysing ● Inferring ● Applying ● Comprehending ● Making real world connection ● Communicating
● Estimate sums to 100. ● Apply strategies (such as counting on, double facts for 50, benchmark of 20, relating facts for 10 etc.) to find sums to 100.	II-A9 Addition Strategies: Sums till 100	● Estimating ● Comparing ● Representing ● Decision making ● Recording ● Communicating

● Estimate differences to check the reasonableness of answers acquired.
● Apply strategies (such as double facts for 50, benchmark of 20, relating to a known fact, counting on and etc.) for subtracting:
  o 2-digit numbers from 1-digit numbers
  o 2-digit from 2-digit numbers
● Mentally subtract numbers till 20.
	II-A10 Subtraction Strategies: 1-Digit Numbers from 2-Digit Numbers 2-Digit Numbers from 2-Digit Numbers	● Estimating
		● Comparing
		● Representing
		● Decision making
		● Recording
		● Communicating

● Model situations to represent addition and subtraction facts ● Examine the relation between addition and subtraction facts (Addition and Subtraction undo each other) then apply the concept while performing addition or subtraction.	II-A11 Addition and Subtraction Facts: Represent Addition and Subtraction Facts Relation of Addition and Subtraction	● Representing / Modelling ● Examining ● Analysing ● Inferring ● Applying ● Predicting ● Reasoning ● Communicating

Strand B: Patterns and Algebra

Competencies for Class II

1. Identify even numbers as doubles of a number and apply the concept to deal with numbers in various mathematical situations.

2. Recognise repeating, growing and shrinking patterns of numbers and apply the concept to interpret and describe sequences.

3. Identify patterns in the additional table and apply it to calculate sums and differences effectively.

4. Respond to open sentence problems by exploring patterns in addition and subtraction.

5. Explain how place value increases in relation to the value of the place to its right.

Learning Objectives	Content	Process/ Essential Skills
● Recognize the pattern in even and odd numbers.(Even numbers doubles) ● Model the pattern in even numbers by folding rectangles.	II-B1 Even and Odd Numbers	● Examining ● Analysing ● Inferring ● Identifying ● Modelling ● Representing ● Communicating

• Describe repeating, growing and shrinking number patterns. • Compare simple number patterns. • Create Growing and shrinking number patterns.	II-B2 Compare Number Patterns	• Examining • Identifying • Comparing • Analysing • Interpreting • Designing • Communicating
• Discover missing addends/subtrahends or the missing sums/differences while exploring simple patterns in addition and subtraction.	II-B3 Finding Patterns Using Addition Table	• Examining • Analysing • Inferring • Predicting • Reasoning • Communicating
• Discover missing factors or the missing products/quotient. • Explain the strategy used to solve an open sentence problem.	II-B4 Open Sentences: Simple Patterns in Addition and Subtraction	• Examining • Predicting • Reasoning • Communicating
• Infer that each place value increases ten times the value of the place to its right • Explain what happens to the number when the model is changed, adding or subtracting 10s and 100s concretely & symbolically.	II-B5 Place Value Patterns	• Modelling • Representing • Examining • Analysing • Interpreting • Reasoning • Communicating

Strand C: Measurement

Competencies for Class II

1. Demonstrate the ability to measure length and perimeter using appropriate standard units (m and cm) and justify the use of standard units in real life.

2. Demonstrate the ability to measure capacity of containers in Litre and make appropriate estimation of the capacity of common containers.
3. Use the standard unit, kg, to estimate and measure the mass of the objects.
4. Use non-standard units to estimate and measure the area of flat surfaces to relate it with our everyday life.
5. Read time as hours, days, weeks, months, seasons and relate to our everyday life.

Learning Objectives	Content	Process/ Essential Skills
● Justify use of standard units by examining various situations. ● Justify how long a centimetre and a metre are. ● Estimate and measure length in cm and m. ● Estimate and measure perimeter in cm. ● Examine and recognize the relation between metre and centimetre (1 metre is 100 cm long).	II-C1 Measuring Length Using Metre and Centimetre Measuring Perimeter using cm	● Examining ● Investigating ● Comparing ● Analysing ● Inferring ● Estimating ● Decision making ● Measuring ● Recording ● Relating ● Communicating
● Identify various containers which have the capacity of 1 Litre. ● Examine various capacities in relation to a litre (how much it takes to make a litre) Compare and order different containers based on their capacity.	II-C2 Estimate and Measure Capacity Using Litre	● Examining ● Investigating ● Comparing ● Analysing ● Inferring ● Estimating ● Measuring ● Recording ● Relating ● Communicating
● Estimate & measure mass using Kilogram, using a pan balance.	II-C3 Estimating and Measuring	● Examining

● Express how heavy a kilogram feels in relation to mass of other objects (lighter than/ heavier than).	Mass using Kilogram	● Investigating ● Comparing ● Analysing ● Inferring ● Estimating ● Measuring ● Recording ● Relating ● Communicating
● Estimate area of a surface using concrete objects. ● Measure area of surfaces using concrete objects (non-standard units) ● Explain that the use of bigger units result in smaller counts and vice versa.	II-C4 Estimate and Measure Area Using Non-Standard Units	● Examining ● Investigating ● Comparing ● Analysing ● Inferring ● Estimating ● Decision making ● Measuring ● Relating ● Communicating
● Read time to the nearest half hour and quarter hour on both analog and digital clocks ● Relate the number of days the week, months of the year and seasons (in context).	II-C5 Measuring Time: Reading Time in Half Hours and Quarter Hours Exploring Calendar	● Examining ● Investigating ● Comparing ● Analysing ● Interpreting ● Decision making ● Measuring ● Relating ● Estimating ● Communicating

Strand D: Geometry

Competencies for Class II

1. Identify and recognize similarities and differences between objects in space when viewed from different distances and angles.
2. Distinguish 3-D shapes from 2-D shapes by identifying and describing the attributes of shapes.
3. Recognize the features of parallel lines and identify parallel lines in our surroundings.
4. Describe reflective symmetry by investigating symmetry in the environment.

Learning Objectives	Content	Process/ Essential Skills
• Recognize figures or objects in space regardless of size, position, or orientation (shapes viewed from a different distance or different viewpoint) • Recognize that a shape or size is stable even if it appears to be different to the observer. • Identify the similarities and differences between or among objects.	II-D1 Spatial sense: Perceptual Constancy Visual Discrimination	• Observing • Identifying • Inferring • Classifying • Relating • Communicating
• Examine the attributes of 3-D and 2-D shapes through sorting, building structures, using manipulative like pattern blocks, linking cubes, coloured counters etc. • Identify, name, describe prisms & pyramids • Distinguish prism and pyramids by investigating their attributes.	II-D2 3-D and 2-D Shapes	• Observing • Identifying • Examining • Comparing • Classifying • Analysing • Communicating
• Represent and discuss the meaning of parallel lines	II-D3 Parallel Lines	• Examining • Representing

Learning Objectives	Content	Process/ Essential Skills
● Generate one's own definition of parallelogram upon investigating parallel lines.		● Comparing ● Investigating ● Analysing ● Inferring ● Identifying ● Communicating
● Identify that half of the shape is the mirror image of the other half. ● Identify more than one line of symmetry in shapes. ● Describe symmetry in a real world environment.	II-D4 Reflective Symmetry	● Examining ● Identifying ● Interpreting ● Inferring ● Communicating

Strand E: Data Management and Probability

Competencies for Class II

1. Collect and record data using tallies to gather information for an appropriate purpose.
2. Interpret and create pictographs, having 1 symbol/picture representing 1 unit.
3. Interpret and create bar graphs, having 1 square representing 1 unit.
4. Investigate mathematical and real-life events to describe the probability of future events as likely and unlikely events.

Learning Objectives	Content	Process/ Essential Skills
● Identify a problem/situation to conduct a survey. ● Conduct simple surveys based on verbal or written questions. ● Collect and record information using tallies. ● Make and modify predictions based on data collected or presented.	II-E1 Collect and Organise Data	● Planning ● Collecting data ● Organising ● Examining ● Investigating ● Interpreting ● Decision making

		● Communicating
● Recognize, interpret and create pictographs. ● Use 1 symbol/picture to represent 1 unit. ● Use both vertical and horizontal orientations to create and interpret pictographs.	II- E2 Pictographs: Interpret and Create Pictographs	● Examining ● Comparing ● Analyzing ● Interpreting ● Representing ● Designing ● Communicating
● Recognize, interpret and create bar graphs. ● Use 1 symbol/picture to represent 1 unit. ● Use both vertical and horizontal orientations to create and interpret bar graphs	II-E3 Bar Graphs: Interpret Bar Graphs Create Bar Graphs	● Examining ● Comparing ● Analysing ● Interpreting ● Representing ● Designing ● Communicating
● Predict and describe probability outcomes of various events using terms 'likely' or 'unlikely'. ● Conduct experiments on probability of various mathematical and real life events.	II-E4 Probability Language: Likely and Unlikely Events Conducting Experiments	● Predicting ● Experimenting ● Investigating ● Inferring ● Making real-life connections ● Communicating

Class III

Strand A: Numbers and Operations

Competencies for Class III

1. Express 4-digit numbers in various ways and apply the skill to effectively express large quantities and value of money in real life.

2. Demonstrate the ability to interpret fractions and use fractions to describe parts in real life situations.

3. Demonstrate the ability to use the concept of decimal tenth to interpret decimal representations in the real world situation.

4. Examine relations among the currency notes, till Nu 1000 use the knowledge to trade effectively in real life situations.

5. Add three digit numbers in various ways and use estimation to check the reasonableness of the sum obtained.

6. Estimate difference of 3-digit numbers to determine the reasonableness of the answer obtained after subtracting in various ways.

7. Perform mental addition and subtraction using various strategies and solve real life problems effectively, using appropriate strategies.

8. Relate repeated addition with multiplication and solve real world problems involving multiplication, effectively.

9. Demonstrate the ability to use properties of multiplication to multiply single digit numbers accurately.

10. Use appropriate strategies to solve multiplication of 2-digit numbers by single digit numbers encountered in real world experiences.

11. Interpret a division problem in a real life situation and solve it effectively using appropriate strategies.

12. Interpret the relation of multiplication and division and apply it to solve problems effectively.

Learning Objectives	Content	Process/ Essential Skills

• Read 4-digit numbers correctly.
• Represent 4-digit numbers correctly in different ways, using:
  o Place Value Charts.
  o Base-Ten Blocks
  o Dummy Ngultrum notes
• Compare and order 4-digit numbers using various methods, correctly.
	III-A1 Numbers to 4-digits	• Identifying
		• Representing
		• Comparing
		• Ordering
		• Making connection
		• Communicating

• Interpret and read modelled fractions (till tenths) as a part of a whole and set, in various ways. • Model fractions, till tenths, concretely, pictorially, and symbolically, as part a whole and part of a set. • Discuss representations of fractions in real life to solve simple problems using the concept of fractions.	III-A2 Fractions till tenths	• Examining • Analysing • Interpreting • Modelling • Making real-world connection • Communicating
• Explain the concept of tenths in place value systems using a place value chart, in simple language. • Explain tenths as part of a whole divided into 10 equal parts. • Model decimal tenths using concrete objects or by drawing pictures. • Express the relation of decimal tenth and a tenth fraction.	III-A3 Decimal Tenths	• Investigating • Inferring • Modelling • Relating • Communicating
• Identify the value of currency notes till 1000.	III-A4 Money	• Identifying • Representing • Comparing • Making connection

		● Communicating
● Estimate sums of 3-Digit whole numbers to determine the reasonableness of the answer obtained. ● Add 3-Digit whole numbers (without regrouping), concretely, pictorially and symbolically. ● Add 3-digit whole numbers with regrouping, concretely, pictorially and symbolically. ● Use and explain the alternative paper-and-pencil algorithm to solve problems related to addition, appropriately. ● Solve word problems involving addition of 3-digit whole numbers, using pencil-paper algorithm, correctly. ● Create word problems involving addition of 3-digit whole numbers and assess the solution to the problems, appropriately.	III-A5 Add 3-digit Whole numbers	● Estimating ● Regrouping ● Representing ● Comparing ● Analysing ● Communicating
● Estimate difference of 3-digit whole numbers to determine the reasonableness of the answer obtained. ● Subtract 3-digit whole numbers (without regrouping) concretely, pictorially and symbolically. ● Subtract 3-digit whole numbers by regrouping concretely, pictorially and symbolically. ● Use and explain the alternative paper-and-pencil algorithm to solve problems related to subtraction. ● Solve word problems involving	III-A6 Subtract 3-Digit Whole Numbers	● Estimating ● Comparing ● Analysing ● Regrouping ● Representing ● Creating ● Communicating

subtraction of 3-digit whole numbers, using pencil-paper algorithm. ● Create word problems involving subtraction of 3-digit whole numbers and assess the solution to the problems		
● Use different strategies to calculate sums and differences mentally. ● Explain the strategies used for calculating sums and differences mentally. ● Choose an appropriate strategy to solve a given problem, mentally.	III-A7 Add and Subtract 3-digit Numbers Mentally	● Observing ● Applying ● Comparing ● Analysing ● Decision making ● Reasoning ● Communicating
● Explain multiplication as repeated addition with concrete, pictorial representations.	III-A8 Multiplication – Meaning	● Observing ● Identifying ● Representing ● Inferring ● Communicating
● Identify properties of multiplication and perform single digit multiplication. ● Apply strategies for multiplications up to 9 x 9. ● Apply multiplication facts such as double facts (e.g., 2 x 7 = 14, so 4 x 7 = 2 x (2 x 7) = 2 x 14 = 28) to solve problems.	III-A9 Multiplication Properties	● Observing ● Identifying ● Representing ● Inferring ● Recording ● Decision Making ● Calculating ● Communicating

• Estimate products of multiplication of 2-digit numbers by 1-digit numbers, reasonably. • Multiply 2-digit numbers by 1-digit numbers using concrete, pictorial and symbolic representations, accurately. • Use and explain the algorithm of multiplying 2-digit numbers by 1-digit numbers, appropriately. • Solve relatable problems involving multiplication of 2-digit numbers by 1-digit numbers efficiently. • Create word problems that can be solved by multiplying 2-digit numbers by 1-digit numbers.	III-A10 Multiplying 2-digit by 1-digit numbers	• Estimating • Representing • Relating • Problem solving • Recording • Creating • Communicating
• Identify division as equal groups/sets, as equal shares and as repeated subtraction, according to given situations. • Model division concretely, pictorially and symbolically to solve division problems effectively. • Justify the method chosen to solve a given division problem.	III-A11 Division Meaning	• Observing • Inferring • Representing • Recording • Reasoning • Comprehending • Communicating
• Interpret models and explain the relation between multiplication and division. • Write multiplication and division of the fact family. • Identify and explain the meaning of each factor.	III-A12 Multiplication and Division	• Examining • Modelling • Analysing • Inferring • Interpreting • Recording • Problem solving

		● Communicating

Strand B: Patterns and Algebra

Competencies for Class III

1. Demonstrate the ability to recognize repeated addition patterns in representations of multiplication to interpret and solve multiplication problems.

2. Examine patterns observed in multiplication and work with new multiplication facts effectively.

3. Explore the patterns in multiplication and division through open sentence problems to enhance problem solving skills in real life.

4. Interpret the place value pattern and describe thousands in terms of hundreds and tens.

Learning Objectives	Content	Process/ Essential Skills
● Identify the pattern in repeated addition and record as multiplication fact.	III-B1 Multiplication as Repeated Addition	● Observing ● Identifying ● Representing ● Inferring ● Communicating
● Explain patterns observed in multiplication tables. ● Use the patterns in the multiplication table to find the products of a given multiplication problem.	III-B2 Multiplication Table Pattern	● Observing ● Identifying ● Representing ● Inferring ● Recording ● Calculating ● Communicating
● Discover missing factors or the missing products/quotient. ● Explain the strategy used to solve an open sentence problem.	III-B3 Open Sentences	● Examining ● Modelling ● Analysing ● Inferring

Learning Objectives	Content	Process/ Essential Skills
		- Interpreting - Recording - Problem solving - Communicating
- Explain the increase in place value in relation to the value of the place to its right. - Represent and describe numbers till 1000 as groups of Tens and Hundreds, correctly.	III-B4 Place Value Pattern Base-Ten System to Thousands	- Identifying - Representing - Making connection - Communicating

Strand C: Measurement

Competencies for Class III

1. Identify angles in the real world environment and describe them in comparison to right angles.
2. Express the relationship among the four units of measuring length (km, m, cm, and mm) and describe real life usage of the units.
3. Demonstrate the ability to use the unit Litre and Millilitre to describe the estimation and measurement of capacity of containers used every day.
4. Relate the units kilogram and gram to estimate and measure mass of objects in everyday life.
5. Relate centimetre square grid to the standard unit (square centimetre) to measure area and record the measurement using standard units.
6. Express correct measurement of time in relation to different units of time and apply the concept to manage time effectively in real life situations.

Learning Objectives	Content	Process/ Essential Skills
- Compare angles directly to the right angle. - Describe angles as less or more than a right angle.	III-C1 Angles	- Examining - Comparing - Classifying - Identifying - Modelling

• Identify angles in the environment which are right angles, more/less than right angles.		• Communicating
• Estimate and measure length using centimetre (cm), millimetre (mm), metre (m) including perimeter context. • Examine the relation between cm and mm, cm and m, m and km. • Choose the appropriate unit (km, m, cm, and mm) to measure length. • Measure distance around regular objects using different units.	III-C2 Length: Relationship among different units	• Estimating • Measuring • Investigating • Relating • Decision making • Reasoning • Recording • Communicating
• Estimate and measure capacity using litre and millilitre • Examine the relation of litre and millilitre (1L = 1000 mL) to realize that millilitre is an extremely small unit. • Choose appropriate unit (L/mL) to measure capacity	III-C3 Capacity: Measuring Capacity in Litre Measuring capacity in Millilitre	• Estimating • Measuring • Investigating • Relating • Decision making • Reasoning • Recording • Communicating
• Estimate and measure mass in kilogram and gram. • Describe the correlation of litre and millilitre (1kg = 1000 g) to infer that gram is used to measure very light objects. • Choose appropriate unit (kg/g) to measure mass.	III-C4 Mass: Measuring Mass in Kilogram Measuring Mass in Gram	• Estimating • Measuring • Investigating • Relating • Decision making • Reasoning • Recording • Communicating

• Estimate and measure the amount of surface space of common objects using non-standard units and square centimetre. • Use centimetre square grids to measure the area of regular and irregular shapes. • Explain the standard unit of measuring area, square centimetre (sq. cm) in relation to the use of square centimetre grid.	III-C5 Area	• Estimating • Measuring • Investigating • Analysing • Relating • Inferring • Recording • Communicating
• Relate digital and analog clocks. • Read and write time in different ways on analog and digital clocks. • Examine the relation among different units of time such as minute, hour, days of the week and months of the year.	III-C6 Measuring Time: Reading Time on Analog and Digital clocks Relation among different units of Time	• Investigating • Interpreting • Recording • Relating • Calculating • Communicating

Strand D: Geometry

Competencies for Class III

1. Classify shapes as regular polygons and quadrilaterals and identify these shapes in their environment.
2. Examine the attributes of squares and rectangles and distinguish squares as a special rectangle.
3. Demonstrate the understanding of the concept of parallelogram by describing parallelogram in one's own words.
4. Distinguish prisms and pyramids by exploring the attributes of 3-D shapes and make connections with the figures and solid shapes around them.
5. Combine, create new shapes, name them and identify similar shapes in the environment.
6. Examine results of transforming 2-D shapes (Turn, slide and flip) and describe images in relation to the original shapes.

7. Explore symmetry in relation to flips and construct personal definition of lines of symmetry
8. Explain the difference between similar and congruent shapes and identify such shapes around them.

Learning Objectives	Content	Process/ Essential Skills
● Classify and describe shapes as regular shapes of quadrilaterals, after examining the attributes of each shape.	III-D1 Polygons	● Examining ● Identifying ● Comparing ● Analysing ● Inferring ● Classifying ● Interpreting ● Communicating
● Examine the attributes of squares and rectangles to identify squares as a special rectangle.	III-D2 Squares & Rectangles	● Examining ● Identifying ● Comparing ● Analysing ● Inferring ● Classifying ● Interpreting ● Communicating
● Generate one's own definition of parallelogram upon investigating the attributes of a parallelogram.	III-D3 Parallelograms	● Examining ● Identifying ● Comparing ● Analysing ● Inferring ● Classifying ● Interpreting ● Communicating
● Recognize, name and describe prisms and pyramids.	III-D4 Prisms & Pyramids	● Identifying ● Examining ● Inferring

● Discover that the shape of the base determines the name of the shape. ● Examine patterns in the attributes of prisms & pyramids (e.g. the number of vertices for all prisms is two times the number associated with its name – a triangular prism has 6 vertices). ● Locate prisms and pyramids around themselves, in the environment.		● Classifying ● Communicating
● Predict results for combining triangles & quadrilaterals by visualizing. ● Construct various polygons using combinations of triangles and quadrilaterals to validate their predictions.	III-D5 Combining two or More Shapes	● Predicting ● Constructing ● Comparing ● Analysing ● Inferring ● Interpreting ● Communicating
● Perform transformation of 2-D shapes by sliding, flipping and turning. ● Examine various lines of reflection in polygons. ● Define line of symmetry and reflective symmetry in simple words.	III-D6 Turns, Slides and Flip of 2-D Shapes	● Examining ● Illustrating ● Comparing ● Analysing ● Defining ● Communicating
● Identify the difference between similar and congruent shapes.	III-D7 Similar and Congruent Shapes	● Examining ● Comparing ● Analysing ● Inferring ● Interpreting ● Communicating

Strand E: Data Management and Probability

Competencies for Class III

1. Select appropriate strategies for collecting and organising data to help present an appropriate description of the collected data and later create their own learning goals and track them.
2. Interpret and create pictographs and bar graphs that have one symbol/picture representing more than 1 unit to enhance data interpretation skills.
3. Predict and describe probability outcomes of various mathematical and real- life events using probability language.
4. Conduct experiments on probability of various mathematical and real life events and apply the findings to make appropriate decisions in real life.

Learning Objectives	Content	Process/ Essential Skills
- Select appropriate strategies for collecting and displaying data. - Inspect considerations when collecting data such as: - Where is a good source? - Where should I conduct the survey? - Does it matter when the survey is conducted? - How should the questions be phrased? - Describe the collected data.	III-E1 Data Collection	- Planning - Collecting Data - Recording - Organizing - Investigating - analysing - Describing - Decision Making - Communicating
- Construct pictographs where each symbol represents more than one item. - Interpret pictographs.	III-E2 Pictograph	- Investigating - Designing - Interpreting - Decision Making - Communicating
Create and interpret bar graphs for which each section represents a value	III-E3 Bar Graph	- Investigating - Designing

greater than one using simple scales for larger numbers. ● Construct both horizontal and vertical graphs.		● Interpreting ● Decision Making ● Communicating
● Predict and describe probability of outcomes of various events using terms 'more likely' or 'less likely'	III-E4 Probability language	● Predicting ● Making real-life connections ● Inferring ● Communicating
● Conduct experiments on probability of various mathematical and real- life events and record outcomes. ● Investigate every day & fictional events to realize that theoretical predictions may not prove true given a set of tries. ● Describe probability of events terms of simple fractions (E.g., '2 out of 5').	III-E5 Conducting Probability Experiments	● Predicting ● Making real-life connections ● Inferring ● Experimenting ● Recording ● Communicating

Class IV

Strand A: Numbers and Operations

Competencies for Class IV

1. Demonstrate an understanding of reading, writing and modelling whole numbers to 5 places and apply it while shopping.

2. Demonstrate the ability to compare and order whole numbers to 5-digits, and apply the understanding in day-to-day activities.

3. Demonstrate the ability to compare, rename and order fractions and use them for day-to-day life activities.

4. Demonstrate an understanding of modelling, recording, comparing and ordering decimals to hundredth.

5. Demonstrate an understanding of adding and subtracting of decimals, (10ths and 100ths) wholes through solving questions related to price of things, weight and length.

6. Demonstrate the ability to multiply 3-digit by 1-digit with and without regrouping after learning the fact and properties of multiplication and solve real world problems.

7. Demonstrate the ability to divide 3-digit by 1-digit numbers without and with regrouping after learning the facts and properties of division and solve related real world problems.

8. Demonstrate the ability to use mental strategies to add and subtract mentally up to 4-digit numbers and apply in the real world situation.

9. Demonstrate the ability to develop and use mental strategies to multiply mentally by 10 and 100.

10. Demonstrate the ability to use open frame equations as numbers or digits.

Learning Objectives	Content	Process/ Essential Skills
● Recognize the actual value of each digit of a number. ● Read and record numbers in several ways. ● Include numbers with zero and value it. ● Write numbers in expanded form ● Estimate the values of numbers.	IV-A1 Place Value Model Whole Numbers to 5 Places	● Estimation ● Modelling
● Identify numbers greater or less than a given number. ● Identify numbers between given numbers ● Order two or more numbers.	IV-A2 Compare and Order Whole Numbers to 5-digits	● Justifying ● Identifying ● Comparing
● Develop visual images for fractions and mixed numbers through concrete materials. ● Use contexts which include part of a whole, part of a group. ● Investigate using concrete materials to conclude that two or more fractions can have different names but the same value. ● Investigate number patterns in equivalent fractions. ● Compare fractions visually in different situations. ● Compare fractions with same denominators and numerators.	IV-A3 Modelling Mixed Numbers 4-A4 Renaming Fractions 4-A5 Compare and Order Fractions	● Visualising ● Modelling ● Patterning ● Renaming ● Comparing ● Application
● Develop the concept of hundredths in the place- value system. ● Develop as a result of the continuing pattern of dividing by 10. ● Relate decimal hundredth to	IV-A6 Model and Record Hundredths 4-A7 Compare and Order Hundredths	● Modelling ● Patterning ● Recording ● Relating ● Comparing

models. ● Explore the relationship between decimals and fractions. ● Compare the whole number part first, decimal part second.		
● Recognize the actual value of each digit. ● Develop strategies for adding and subtracting decimals and whole. ● Discover, through investigation, that the process of adding and subtracting tenths or hundredths is the same as adding and subtracting whole numbers. ● Estimate the sum and difference of the whole number and decimal number.	IV-A8 Addition and Subtraction of Decimals and Wholes	● Estimating ● Recognizing
● Explore various meanings of multiplication. ● Show multiplication as skip counting and repeated addition. ● Recognise multiplication as a combination of rate time quantity. ● Explore commutative, distributive, and associative, zero, 1. ● Develop facts through concrete, pictorial and symbolic representations till 9 × 9 ● Develop alternate and standard algorithms (from understanding) ● Use estimation to predict and verify products.	IV-A9 Multiplication Meanings IV-A10 Multiplication Properties IV-A11 Multiplication Facts IV-A12 Multiply 3-digit by 1-Digit	● Conceptualising ● Computing ● Comparing ● Representing ● Prediction ● Estimation
● Read division as groups or shares ● Recognize division in contexts of rate, comparison, combinations. ● Explain that when o a number is divided by 1 the	IV-A13 Division Meaning IV-A14 Division Properties of 0, 1	● Conceptualising

quotient is the number itself. o a number is divided by the number itself, the quotient is 1. o a number divided by 0 is meaningless. o 0 divided by a number gives 0 as the quotients. ● Demonstrate that order matters in division (opposite to multiplication).		
● Explain multiplication and division as two ways of looking at the same situation. ● Relate division facts by connecting with multiplication.	IV-A15 Multiplication and Division Facts	● Connecting ● Conceptualising
● Develop sharing or grouping algorithms. ● Connect algorithms to models. ● Justify remainders in real life as a fraction, ignored, rounded, addressed specifically (depending on context). ● Continue estimating as a first step. ● Estimate quotient.	IV-A16 Divide 2 or 3-digit Number by 1-Digit Number With or without regrouping	● Estimation, ● Modelling ● Reasoning
● Develop and use mental strategies: front end, compensation, counting on/back, compatible numbers. ● Determine if a problem can be solved mentally.	IV-A17 Add and Subtract Mentally (upto 4 digits)	● Strategizing ● Analysing
● Develop visual images of whole numbers multiplied by 10 or 100 (base ten materials - that number of rods or flats). ● Read numbers in different ways (e.g., 5300 is often read as 53 hundred, rather than 5 thousand, 3	IV-A18 Multiply Mentally by 10 or by 100	● Conceptualising ● Reading Numbers

	hundred).			

Learning Objectives	Content	Process/ Essential Skills
• Explain that an open frame can represent a number or a digit (4 × 5 = 30). • Calculate the unknown value to make the sentence true.	IV-A19 Open Frame as Numbers or Digits	• Representing • Computing

Strand B: Patterns and Algebra

Competencies for Class IV

1. Demonstrate the ability to apply patterns to solve computational problems in real life situations.

2. Demonstrate the ability to solve open sentences involving multiplication and division using patterns.

3. Identify patterns visually and represent symbolically for increasing power of 10.

Learning Objectives	Content	Process/ Essential Skills
• Apply patterns to solve computation problems related to multiplication (e.g., multiplying by 8, 9, 11, 10).	IV-B1 Apply Pattern to Solve Problems	• Exploring • Applying
• Describe open and closed sentences with examples. • Solve open sentences involving multiplication and division. • Generate rules about how a change in one variable affects the result.	IV-B2 Open Sentences and Computation Patterns	• Reasoning • Computing • Creating
• Identify and continue patterns with increasing powers of ten visually and symbolically.	IV-B3 Multiplying by 10, by 100, by 1000	• Estimating • Recognising

Strand C: Measurement

Competencies for Class IV

1. Exhibit the ability to estimate, measure and develop unit relationships between different units of measuring length (mm, cm, m, km) and apply it in real life situations.
2. Demonstrate the ability to estimate, measure and describe the relationship between the dimensions and area.
3. Apply the concept of area to calculate the area of shapes in the immediate surroundings.
4. Estimate and measure volume using standard and non- standard units and implement its understanding while measuring/finding volume in a real situation.
5. Apply the concept of area to calculate the area of rectangular and square shapes in the immediate surroundings.

Learning Objectives	Content	Process/ Essential Skills
- Estimate and measure in mm, cm, m and km. - Develop a sense of longer units. - Investigate and develop unit relationships - Explore relationship between roots of words: milli, centi, deci, m, deca, hecto, kilo.	IV-C1 Estimate and Measure Lengths	- Estimating - Investigating - Comparing
- Demonstrate meaning of area as the number of units required to cover a given surface. - Estimate and measure area using square centimetre (cm2) units. - Investigate areas of different objects with the same perimeter, and perimeters of different objects with the same area. - Relate dimensions of rectangles to area concretely.	IV-C2 Area Explore meaning. Estimate and measure. Concept of square cm. Relate dimensions and Area (of rectangles) to	- Conceptualizing - Estimating - Computing - Relating - Investigating - Analysing - Reasoning

	factors and products. Constant area and different perimeters.	
• Recall volume as the number of cubes it takes to build a solid. • Estimate and measure volume in non-standard units and by using standard units (cm cubes). • Estimate, then calculate to verify the volume of rectangular prisms. • Determine the volume of a rectangular prism and build prisms with a specified volume. • Relate volume to dimensions (dimensions of first layer × number of layers) from any side.	IV-C3 Volume Explore meaning. Estimate and Measure volume of rectangular prism o using non-standard units o using standard units	• Conceptualizing • Estimating • Connecting • Computing

Strand D: Geometry

Competencies for Class IV

1. Create triangles after discovering the properties and give appropriate names for each of the triangles.
2. Demonstrate the ability to predict and verify the shapes by combining smaller and known shapes.
3. Demonstrate the ability to model and construct skeletal models of cylinders, cones, prisms and pyramids.
4. Display the ability to predict and finally confirm the results for 2-D shape transformations after doing practically (Slides, Flips, and Turns [half, quarter]).
5. Identify properties of various quadrilaterals and confirm the reflective symmetry of shapes given to them.
6. Demonstrate the ability to explore a variety of materials to confirm that congruent polygons are a perfect match.
7. Describe and classify angles formed by structures, objects and landscape around them as right, acute and obtuse.

Learning Objectives	Content	Process/ Essential Skills
● Use concrete materials to discover the properties of equilateral, isosceles, scalene. ● Sort by various properties like number of lines of symmetry, number of identical angles. ● Recognize and draw or create three different triangles based on sides.	IV-D1 Triangles Discover properties Construct concretely	● Conceptualising ● Classifying ● Connecting
● Find all possibilities from a given set of shapes. ● Predict first, then verify by combining. ● Create composite shapes using manipulations like tangram, pattern blocks, linking cubes.	IV-D2 Composite Shapes	● Estimating ● Constructing
● Construct 3-D skeletal models using straw, modelling clay, dough etc. ● Examine the similarities and differences between any pair of 3-D shapes.	IV-D3 Construct Models cylinders, cones, prisms, pyramids	● Constructing ● Connecting
● Demonstrate understanding of the concepts of slides, flips and turns. ● Predict and confirm results for 2-D shapes under transformations.	IV-D4 Slides, Flips, Turns (half, quarter)	● Conceptualising ● Demonstrating
● Explore properties of various quadrilaterals. ● Make generalisations that focus on reflective symmetry properties.	IV-D5 Reflective Symmetry	● Conceptualising ● Analysing
● Determine that congruent polygons are a perfect match. ● Use a variety of materials like pattern blocks, tangrams, pictures of shapes and tracings to show the congruence of polygons.	IV-D6 Congruence of Polygons	● Conceptualising ● Connecting

Learning Objectives	Content	Process/ Essential Skills
- Develop meaning of area as amount of turn concretely and pictorially (smaller angle = smaller turn). - Draw a conclusion by investigating that length of arms of an angle does not influence angle size. - Differentiate and describe right, acute and obtuse angles. - Draw angles using pencil, ruler and protector.	IV-D7 Angles Explore meaning 4-D8 Draw angles	- Investigating - Predicting - Analysing

Strand E: Data Management and Probability

Competencies for Class IV

1. Demonstrate the ability to describe the collected data in multiple ways and draw conclusions about everyday issues.
2. Construct and interpret bar graphs and pictographs using the data from real life.
3. Demonstrate the ability to plot the ordered pairs on the coordinate grid and locate the places.
4. Demonstrate the ability to describe probability using fractions and words and apply it to real life probability events.

Learning Objectives	Content	Process/ Essential Skills
- Collect data using appropriate tools. - Make decisions about format of presentation (charts, tables, graphs) - Determine the maximum and minimum data values from given numerical data	IV-E1 Collect, Organise and Describe Data	- Planning - Organizing - Representing
- Choose the appropriate scale and symbol for the pictograph. - Construct the graphs with appropriate labelling. (Include both vertical and horizontal representations). - Interpret and draw conclusions from the graphs.	IV-E2 Construct and Interpret Pictographs and Bar Graphs	- Representing - Constructing - Relating - Analysing

• Describe the importance of ordered pairs. • Plot the points in the coordinate graph. • Name the points in the coordinate graph. • Use terminology: "axes,""coordinates,""plot," and "origin"	IV-E3 Ordered Pairs	• Conceptualising • Plotting
• Predict whether an outcome is more likely, equally likely or less likely to occur • Relate probability of an event to fractions • Describe probability using probability words.	IV-E4 Describing Probability using Fractions	• Connecting • Predicting

Class V

Strand A: Numbers and Operations

Competencies for Class V

1. Demonstrate the ability to interpret 7-digit numbers in different ways and apply in real life situations.

2. Compare and order 7-digit whole numbers in different notation and use it while dealing with larger numbers.

3. Rename, compare and order fractions with and without models.

4. Apply the concept of comparing and ordering fractions in appropriate situations.

5. Compare and order numbers to thousandths with and without models.

6. Apply the concept of comparing and ordering thousandths in appropriate situations.

7. Demonstrate the ability to add and subtract decimals up to thousandths and use the concept of it in appropriate situations.

8. Explore the idea of ratios and rates and apply them in the situation demands.

9. Demonstrate ability to multiply numbers (2 digits by 2 digits, 2 digits by 3 digits and 4 digits by 1 digit) and use the concept while dealing with large-digit numbers.

10. Demonstrate the ability to divide 4-digit by 1-digit numbers with or without regrouping and apply its understanding outside the classroom.

11. Demonstrate number sense with respect to whole numbers and decimals drawing relationships that are true, not true or sometimes true and be able to solve problems in new situations.

Learning Objectives	Content	Process/ Essential Skills
● Read and represent whole numbers to 7-digits. ● Demonstrate understanding of place value patterns as groups of 3	V-A1 Place Value Whole Numbers to 7 digits	● Representing ● Identifying ● Comparing

82

• Interpret whole number in different ways (eg- 1,500,000 = 1 ½ million, 1.5 million) • Justify interpretation. • Develop a sense of how big a million is, through investigations.	V-A2 Interpret Millions	• Investigating • Interpretation • Reasoning

• Compare and order large numbers
  o in standard notation (34,256,876 > 34,255,996)
  o in decimal notation (34.25 million < 34.3 million)
  o both (34,256,876 < 35.2 million)
• with different units (3,423 thousand > 3,325,146).
	V-A3 Compare and Order Large Numbers	• Visualising
		• Modelling

• Develop relationship between fractions and division. • Use division meaning to change an improper fraction to a mixed number. • Link concrete, pictorial and symbolic representation of fractions.	V-A4 Meaning of Fraction as Division	• Patterning • Renaming • Connecting
• Develop concepts through concrete materials, then link to symbolic. • Explain that equivalent fractions as the same region are partitioned in different ways. • Explore the relationship between numerator and denominator	V-A5 Rename Fractions with and without models	• Reasoning • Comparing • Connecting

• Develop referent
  o with same denominator
  o with same numerator
  o as mixed numbers
	V-A6 Compare and Order Fractions Using Reasoning	• Reasoning
		• Comparing
		• Connecting

• Develop referents (0.432 is a little less than half a metre) • Place decimal numbers on a number line and justify • Read quantitative value of each digit in decimal numbers (16.5 as	V-A7 Model and record Thousandths	• Modelling • Recording • Reasoning

"sixteen and 5 tenths" or "sixteen and a half")		
● Compare whole number parts first ● Explain that decimal numbers do not need the same number of places after the decimal to be compared (0.7 > 0.423) ● Explain that the number of places after the decimal does not determine size	V-A8 Compare and Order Numbers to Thousandths	● Reasoning ● Analysing ● Ordering ● Reasoning
● Compute mentally and by using pencil and paper using various strategies. ● Add decimal numbers up to thousandths ● Subtract decimal numbers up to thousandths	V-A9 Addition and Subtraction of Decimals (1000ths)	● Estimation ● Computing
● Describe ratio as a multiplicative comparison of two numbers or quantities of the same type. ● Describe rate as a multiplicative comparison of two quantities described in different units. ● Make connections to common ratio and rate situations in geometric, numerical and measurement situations.	V-A10 Explore Ideas About Ratio and Rate	● Comparing ● Connecting
● Extend 3-digit × 1-digit multiplication using similar strategies. ● Develop personal and standard algorithms. ● Estimate before multiplying using a variety of strategies.	V-A11 4-digit x 1-digit Multiplication With and without regrouping.	● Modelling ● Connecting ● Analysing ● Creating
● Relate models to algorithms. ● Develop personal and standard algorithms. ● Estimate before multiplying.	V-A12 2-Digit × 2-Digit Multiplication	● Modelling ● Connecting ● Analysing ● Creating

• Use a variety of strategies to estimate products.	Connect models to algorithms	
• Relate models or diagrams to algorithms. • Develop personal and standard algorithms. • Continue estimating to check.	V-A13 2-digit × 3-digit multiplication With and without regrouping	• Modelling • Relating • Computing • Estimating
• Use prior knowledge of basic facts to multiply by 0.1, 0.01, 0.001 • Link to concrete models to focus on place value.	V-A14 Multiply Mentally Whole Numbers by 0.1, 0.01, 0.001	• Connecting • Modelling
• Use estimation to predict quotients. • Use models to divide and link to algorithms. • Develop personal and standard algorithms. • Explore divisors which are multiples of 10 only (10, 20,....90).	V-A15 4-Digit by 1-Digit Division	• Modelling, • Connecting • Analysing • Creating
• Apply number sense explore numerical situations which are always, sometimes, never true (324 + 4> 300 is always true if 4 is a whole number). • Work with open number sentences involving the four basic operations and a combination of operations. • Recognize that a number can also be expressed as a letter variable or any other shapes or symbol.	V-A16 Applying Number Sense	• Applying • Analysing • Strategizing • Conceptualising

Strand B: Patterns and Algebra

Competencies for Class V

1. Demonstrate application of patterns of basic operations (addition, subtraction, multiplication and division) and apply while solving related problems.

2. Demonstrate the ability to interpret equivalent fractions in different ways and apply it in appropriate situations.

3. Explore the relationship between area and perimeter of rectangles to investigate patterns.

Learning Objectives	Content	Process/ Essential Skills
● Use patterns in dividing by 10, 100 and 1000. ● Use patterns in multiplying by 0.1, 0.01 and 0.001. ● Develop a rule for placement of the decimal point.	V-B1 Place Value Pattern Base Ten System to Millions	● Patterning ● Conceptualising ● Investigating
● Generate rules about how a change in one variable affects the result for all 4 operations. ● Re-arrange factors to simplify computation. ● Realise that dividing one factor and multiplying the other by the same amount produces no change in the final result.	V-B2 Open Sentences: patterns in addition, subtraction, multiplication & division	● Conceptualising ● Analysing ● Reasoning ● Creating ● Computing
● Explain that the multiplicative relationship of numerator/denominator remains constant for equivalent fractions. ● Try creating equivalent fractions by dividing numerator and denominator by common factor. ● Explain the result when numerators of equivalent fractions differ by a constant amount.	V-B3 Explore Equivalent Fraction Multiplicative Relationship	● Estimating ● Investigating ● Reasoning
● Use concrete models to discover patterns: eg. longer the length, shorter the width ● Connect models to symbols: if one dimension is multiplied by a factor, the other must be divided by that factor (e.g. 24 × 5 = 12 × 10)	V-B4 Area and Perimeter	● Modelling ● Investigating ● Connecting

Learning Objectives	Content	Process/Essential Skills
● Explain the pattern of change in units when converting from smaller units to larger units and vice versa. ● Apply the pattern relationship to convert units from smaller to larger and vice versa (linear unit: Litre,metre and gram)	V-B5 SI Measurement Pattern in changing units	● Investigating ● Connecting

Strand C: Measurement

Competencies for Class V

1. Demonstrate the ability to calculate the perimeter and area of polygons (up to 5 sided figures)
2. Explore and estimate the measurement of different angles using protractor and apply it in immediate surroundings.
3. Demonstrate the ability to solve basic problems related to volume and capacity in real life situations.
4. Demonstrate how to use relationships among various SI units and apply its understanding in daily life situations.

Learning Objectives	Content	Process/Essential Skills
● Use models to discover patterns about area and perimeter of rectangles. ● Develop various formulas through investigation from concrete to symbolic. ● Draw a conclusion through investigation that squares with the same perimeter have the same area & vice versa. Example, square with side length of 4 units. ● Draw a conclusion through investigation that squares have the same area and perimeter. ● Draw conclusion through	V-C1 Area and Perimeter of Polygons	● Investigating ● Modelling ● Analysing

investigation that rectangles with the same area can have different perimeters & vice versa.
 	
● Find relation between area and perimeter for
  o triangles
  o rectangles
  o squares
  o regular pentagons pictorially (e.g. using grids).		

● Use benchmark (paper wedge) to estimate angles. ● Link wedges to degrees (degree is just a very small wedge). ● Measure angles of 45, 90, 135, 180 degrees using protractor. ● Estimate angles relative to common referents: 45, 90, 180 degrees (about the same as, more than, less than).	V-C2 Estimating and Measuring Angles	● Investigating ● Reasoning ● Comparing ● Estimating
● Demonstrate understanding of volume as the amount of space an object occupies or how much it takes to build it. ● Find capacity as to how much a container is capable of holding. ● Develop a sense of size and referents for a cubic unit (cm^3, mm^3, m^3) and calculate the volume of a rectangular prism.	V-C3 Volume and Capacity	● Investigating ● Comparing ● Computing ● Estimating
● Apply relationships among different units of length, mass and capacity. ● Rename measures using relationships among and between units. ● Apply referents for various measurement standards (30 cm is like a ruler, 1 dm is about a small hand span, etc.).	V-C4 Relation Between Various SI Units	● Applying ● Representing ● Connecting

Strand D: Geometry

Competencies for Class V

1. Describe properties and spatial sense of triangles using concrete and pictorial representations.
2. Deduce, through exploration, the diagonal properties of squares and rectangles and its importance in construction.
3. Describe the parallelism and perpendicularity along with lines and line segments and realise its importance in the environment.
4. Describe changes in the orientation and position of different 2-D shapes using properties of translations, reflections and rotations, concretely and pictorially.
5. Demonstrate the ability to create and interpret a variety of nets of rectangular prisms, cones and cylinders.

Learning Objectives	Content	Process/ Essential Skills
● Write characteristics of equilateral, isosceles, scalene triangles through investigation using concrete cut-outs as well as using relevant technology.	V-D1 Triangles	● Investigating ● Modelling ● Analysing ● Connecting

● Predict measure of angles through visualisation.
 ● Investigate spatial sense using:
  o two congruent equilateral triangles
  o two congruent isosceles right triangles.
  o two congruent isosceles triangles
  o two congruent right triangles.
  o two congruent acute/obtuse triangles.
  o two different isosceles triangles with a base of the same length.
	V-D2 Combining Triangles	● Estimating
		 ● Comparing
		 ● Reasoning
		 ● Investigating

● Experiment concretely (by folding), visually (using technology) and develop generalisations for diagonals:	V-D3 Diagonal properties of Squares and Rectangles	● Investigating ● Comparing ● Representing

o of squares. o which bisect each other o which intersect to form four right angles (perpendicular bisectors). o which form two pairs of equal opposite angles at the point of intersection. o which form two angles at each vertex of the rectangle that sum to 90° and have the same. measures as the two angles at the other vertices. o which form two pairs of congruent isosceles triangles.		● Conceptualisi ng
● Construct, using geometry tools and also using appropriate mathematical software, lines which are: o parallel to one another. o Intersecting. o perpendicular at an end point. o perpendicular to another line at its midpoint. o bisecting another line but not perpendicular. o bisecting another line and perpendicular. o bisect each other and are perpendicular.	V-D4 Parallelism and Perpendicularit y of Lines and line Segments	● Investigating ● Comparing ● Representing ● Conceptualizin g
● Record properties of: a shape and its translated image, a shape and its reflected image, a shape and its congruent image, through investigation. ● Compare orientation, corresponding parallel sides of shape and reflected image. ● Describe, through investigation, that corresponding points of shape and	V-D5 Translations and Reflections using Horizontal and Vertical lines Generalize and apply properties.	● Investigating ● Comparing ● Analysing ● Conceptualisin g

Learning Objectives	Content	Process/ Essential Skills
reflected image are equidistant from the mirror line. ● Describe, through investigation, that a mirror line is the perpendicular bisector of all segments joining corresponding points (Use appropriate mathematical technology.		
● Predict, draw and identify quarter, half and 3-quarter turns. ● Explain the results of a variety of turn centres (pivot point). ● Relate 90 degrees to quarter turns, 180 degrees to half turns.	V-D6 Rotations: 1/4, 1/2, 3/4 turns. Predict and investigate	● Estimating ● Constructing ● Identifying
● Create and interpret various nets for Cone, Cylinders and Rectangular Prisms.	V-D7 Nets for Cone, Cylinders and Rectangular Prisms.	● Interpreting ● Connecting ● Constructing

Strand E: Data Management and Probability

Competencies for Class V

1. Collect the data on identified issues using relevant tools, and describe the organised data.
2. Demonstrate the ability to construct and interpret double bar graphs on identified issues.
3. Construct coordinate graphs using appropriate labels and scales to locate position of things in 2-D space.
4. Demonstrate the ability to conduct experimental probability and describe probability using words, fractions and decimals.

Learning Objectives	Content	Process/ Essential Skills
● Collect data using relevant tools. ● Organise and describe the collected data (Maximum, minimum, range and Mean).	V-E1 Collect, Organise and Describe Data.	● Planning ● Representing ● Describing

• Construct and interpret simultaneous displays - 2 sets of data from the same population (perhaps taken at different times). • Interpret double bar graph to draw conclusions on the identified issues.	V-E2 Bar and Double Bar Graphs Construct and Interpret	• Representing • Reasoning • Analysing • Interpreting
• Construct a number of coordinate graphs using appropriate labels and scales. • Use coordinate graphs for purposes of location.	V-E3 Coordinate Graphs construct and interpret	• Representing • Reasoning • Analysing • Interpreting
• Determine experimental probability through simple experiments using devices (dice, cards, spinners and coins). • Relate both theoretical probability and experimental probability to fractions and decimals.	V-E4 Experimental and Theoretical Probability	• Connecting • Analysing • Representing

Class VI

Strand A: Numbers and Operations

Competencies for Class VI

1. Demonstrate the ability to apply the concept of factors and common factors to navigate numbers relationships effectively.

2. Distinguish prime numbers from composite numbers and list prime till 100.

3. Read, write and rename whole numbers and decimals to solve problems related to day-to-day life.

4. Apply the concept of renaming the mixed numbers to improper fractions and relate it to the real life situations.

5. Demonstrate the ability to convert and compare simple fractions to decimals and apply the concept in relevant situations.

6. Demonstrate the ability to connect the relationships among ratios, percent and rates and apply the concept in solving real world problems.

7. Demonstrate the ability to use multiplication and division patterns to simplify computations and solve related computational problems.

8. Display the ability to add and subtract fractions with different denominators and apply the concept to solve appropriate word problems.

9. Demonstrate an understanding of multiplication and division of decimals using algorithms and apply the concept in solving related problems.

Learning Objectives	Content	Process/ Essential Skills
● Explain that the number is always a multiple of any of its factors and find the factors of a 2-digits number. ● Investigate and explain that the greatest factor is always the number itself and the least factor is always 1.	VI-A1 Factors of Whole Numbers	● Factorizing ● Investigating

● Investigate and explain that the second greatest factor is always ½ the number or less.		
● Find and list the factors and common factors of the numbers in a systematic way using different methods (Dividing and Multiplying). ● Reason out that 1 is a common factor of any set of numbers.	VI-A2 Common Factors Whole numbers	● Factorizing ● Investigating
● Define prime numbers and distinguish them from composite numbers. ● Investigate and that 1 is not a prime number. ● List all prime numbers till 100.	VI-A3 Prime Numbers Distinguish from composites	● Investigating ● Understanding ● Reasoning
● Read and write numbers in words, and in expanded form.	VI-A4 Reading and Writing Large Numbers	● Patterning ● Connecting ● Representing

● Demonstrate an understanding of place value for numbers less than and equal to one billion and greater than ten thousandth.
● Show that the place values in the decimal number system follow patterns.
  o Each position represents 10 times as much as the position to its left.
  o Each position represents 1/10 as much as the position to its right.
● Explain that numerical positions are grouped in 3s for the purpose of reading them.
● Rename numbers and apply it to solve related problems. (whole numbers)
	VI-A5 Decimal Place Value	● Conceptualising
		● Modelling
		● Connecting

● Read and write decimal numbers. ● Compare and order decimal numbers.		
● Convert improper fractions to mixed numbers and vice versa , and apply the concept to solve real world problems. ● Use pictorial models to illustrate improper fractions and mixed numbers.	VI-A6 Rename Mixed Numbers and Improper Fractions	● Modelling ● Representing ● Relating
● Convert simple fractions to decimals. (Fractions with denominators that are factors of 10, 100, 1000…)	VI-A7 Converting Simple Fractions to Decimals	● Modelling ● Renaming ● Relating
● Compare fractions based on common denominator and common numerator. ● Compare fractions using equivalent decimals and benchmarks.	VI-A8 Comparing Fractions	● Comparing ● Relating
● Explain that ratios and fractions are both comparisons. ● Compare a part to a whole and part to part ratio.	VI-A9 Ratio Part to part Part to whole	● Modelling ● Patterning ● Relating ● Analysing
● Connect models and symbols to develop multiplicative relationships for equivalent ratios and apply it to solve related problems related to part to part and part to whole ratios.	VI-A10 Equivalent Ratios Use models and symbols	● Relating ● Connecting ● Interpreting
● Describe that percent is viewed as a special ratio where the second term is 100. ● Convert percent as fraction, decimal and ratio. ● Represent percentage pictorially (grid).	VI-A11 Percent: Developing Benchmarks (number sense)	● Modelling ● Connecting ● Recognizing

● Find percent equivalents for common ratios like ¼, ½ and ¾ (benchmarks).		
● Explain that rates are just like ratios except that they are comparisons of items in different units. ● Describe rate in more than one way. ● Apply the concept of rate to solve simple related problems.	VI-A12 Rates: Relating to Ratios	● Relating ● Recognizing ● Comparing
● Re-arrange factors to simplify computation (28×250 is more difficult that 7 ×1000). ● Show how a change in either factor affects the product. ● Investigate that dividing one factor and multiplying the other by the same number produces no change in the final result.	VI-A13 Multiplication and Division Computation Patterns	● Reasoning ● Computing ● Creating
● Investigate the constant multiplicative relationship of numerator/denominator and find the equivalent fractions. ● Demonstrate equivalent fraction by subdividing equally. ● Show by equally grouping the fractional pieces that make up the whole. ● Demonstrate the ability to order fractions.	VI-A14 Explore Equivale nt Fractions Multiplicative Relationship	● Estimating ● Investigating ● Reasoning
● Add/subtract fractions with different denominators using models and symbolically. (pattern blocks, fraction strips). ● Solve word problems related to addition and subtraction of	VI-A15 Addition and Subtraction Fractions With Various Denominators	● Conceptualising ● Problem solving

fractions with different denominators.		
● Connect multiplication and division of decimals to whole number multiplication and division. ● Link pictorial models to algorithms. ● Apply estimation strategies.	VI-A16 Multiplication and Division of Decimals	● Connecting ● Estimating ● Applying

Strand B: Patterns and Algebra

Competencies for Class VI

1. Draw conclusions on how changes in base or height affect the area of rectangles, parallelograms and triangles.

2. Explore to infer that changes in one dimension affects the volume of a rectangular prism.

3. Represent geometric and numerical patterns for square and triangular numbers.

4. Solve simple linear open frame equations in context to real life situations.

Learning Objectives	Content	Process/ Essential Skills
● Explore concretely how changes in base/length affect the area of rectangles, parallelograms, and triangles. ● Link concrete to symbols which represent the changes e.g. Parallelograms: A = b × h so if b and h are both doubled, area is doubled if b is doubled but h is halved the area remains the same.	VI-B1 Explore Area Patterns	● Conceptualising ● Connecting
● Explore how changes in one dimension of the formula affects the volume of a rectangular prism and relate this to the volume formula V = l × w × h.	VI-B2 Explore Volume Patterns	● Relating ● Investigating
● Show square and triangular numbers in geometric and numerical patterns.	VI-B3 Square	● Connecting

• Conclude that square numbers are represented in square arrays and are the products of numbers multiplied by themselves. • Show that a triangular number can be modelled as a triangle where each row is one more than the row above it, starting with 1. • Explore pattern rules for square and triangular numbers and apply it to solve related problems. • Demonstrate an understanding of the relationships in the pattern and find the missing values in simple patterns.	and Triangular Numbers	• Conceptualising • Representing
• Replace open frames with letters to represent linear equations. • Solve simple linear equations.	VI-B4 Linear Equations: Using open frames	• Computing • Applying

Strand C: Measurement

Competencies for Class VI

1. Demonstrate the ability to find the area of things/objects around us using appropriate units.
2. Explore the relationship between the area of a parallelogram and the area of the rectangle having the same base and height.
3. Demonstrate the ability to show that the area of a triangle is one-half of the related parallelogram.
4. Demonstrate the ability to apply the knowledge of relationships among various SI units.
5. Demonstrate the ability to calculate the volume of a rectangular prism and relate to capacity.
6. Demonstrate the ability to relate tonne to kg and g and solve relevant real life problems.

Learning Objectives	Content	Process/ Essential Skills
● Calculate the area of objects/things with rectangular or square shape using appropriate units (cm^2, m^2, km^2).	VI-C1 Calculate Area Context Based Problems	● Applying ● Computing
● Show that the area of a parallelogram is the same as the area of a related rectangle. ● Find the base or height, given the area and the other dimensions. ● Show that a variety of parallelograms can have the same area.	VI-C2 Relate Base, Height, Area of Parallelogram	● Computing ● Relating
● Explain that the area of a triangle is one-half of the related parallelogram. ● Describe that as long as the base and height are the same, the areas of visually-different triangles are the same. ● Calculate the missing dimension when area and one of the dimensions is given. (Triangle and rectangle). ● Apply the concept of computing area to solve related real life problems. (Area of a rectangle, parallelogram and triangle). ● Apply formula to calculate the area of composite shapes(rectangle, parallelogram and triangle)	VI-C3 Area of a Triangle abd composite shapes	● Connectin g ● Comparing
● Investigate the relationship between linear, square and cubic SI units and apply the concept in converting SI units.	VI-C4 Investigate Relations Between SI Units	● Connectin g ● Comparing
● Estimate the volume (cubic unit) and capacity (litres) of different containers. ● Investigate and apply the formula to determine the volume of a rectangular prism. ● Find the missing length.	VI-C5 Calculate Volume and Relate to Capacity	● Computing ● Applying

● Relate volume to capacity of rectangular prisms containers and apply it to solve related problems.		
● Explore that 1 Tonne is equivalent to 1000 kg. ● Relate tonne to kg and g and solve related real life problems..	VI-C6 Mass	● Connecting ● Comparing

Strand D: Geometry

Competencies for Class VI

1. Demonstrate the ability to estimate, measure and draw angles between 0 and 180 degrees.
2. Demonstrate the ability to apply the concept of measuring angles to construct triangles.
3. Demonstrate the ability to rotate shapes using various turn centres.
4. Explore the properties of rotational symmetry and the order of turn symmetry of 2-D shapes.
5. Describe that two congruent shapes on the same plane are the images of one another under translation, reflection, rotation or any combination of these three transformations.
6. Demonstrate the ability to identify line bisector and angle bisector in the immediate surroundings.
7. Explore nets to learn more about three-dimensional shapes and their properties in a hands-on, constructive way.
8. Sort and explain the diagonal properties of quadrilaterals and use the concept in real life situations.
9. Explain the planes of symmetry of different 3-D shapes using appropriate representations and determine the number of planes of symmetry in a variety of 3-D shapes.

Learning Objectives	Content	Process/ Essential Skills
● Estimating the measure of angles using 45°, 90°, and 180° as reference angles.	VI-D1 Estimate, Measure and Draw Angles	● Estimating ● Measuring ● Drawing

● Identify different types of angles. (Obtuse, acute, right and straight triangles). ● Demonstrate the ability to measure angles using protractor. ● Draw angles between 0 and 180 degrees.		
● Draw triangles with the given side lengths and angles. ● Demonstrate that the sum of the interior angle of a triangle is 180 degree. ● Explain that the sum of the length of any two sides of a triangle is greater than the length of the third side.	VI-D2 Drawing Triangles	● Creating ● Drawing
● Use a variety of turn centres to rotate a shape by ¼, ½, and ¾ turns.	VI-D3 Rotations: ¼, ½,¾ Turns Rotational	● Relating ● Recognizing ● Investigating
● Investigate whether the shape has rotational symmetry or not. ● Describe that the number of times it appears in the identical position during one complete rotation is the order of rotational symmetry. ● Explore the properties of the rotational symmetry for quadrilaterals and regular polygons. ● Relate rotational symmetry of squares and rectangles to other properties of squares and rectangles.	VI-D4 Properties of Rotational Symmetry	● Understanding ● Recognizing ● Investigating ● Relating ● Generalizing
● Perform translation and reflection of 2-D shapes. ● Identify key properties of three different transformations and differentiate them.	VI-D5 Combining Transformations	● Relating ● Predicting

● Identify a combination of successive transformations of 2 D shapes and describe the transformation. ● Perform a combination of transformation (Reflection and translation; Rotation and reflection; Rotation and translation; Combination of all three transformation) on a single 2D shape.		
● Recognize and describe angle bisectors including perpendicular bisectors. ● Draw and bisect angles and lines.	VI-D6 Bisectors: Angles and Line Segments	● Describing ● Sorting
● Create and interpret various nets for prisms and pyramids.	VI-D7 Nets of Prisms and Pyramids	● Describing ● Interpreting ● Reasoning
● Describe quadrilaterals based on various attributes. ● Sort quadrilaterals by attributes.	VI-D8 Sort Quadrilaterals by Attributes	● Representing ● Sorting
● Explain diagonal properties of the quadrilaterals through exploration (rhombus, parallelogram, kite, and trapezoid).	VI-D9 Generalize Diagonal Properties	● Exploring ● Generalizing ● Relating
● Explain that some 3-D shapes have planes of reflective symmetry. ● Describe, through investigation, that a cube has 9 different planes of symmetry. ● Explore the planes of symmetry of cones, cylinders, prisms, and pyramids.	VI-D10 Planes of Symmetry of 3-D Shapes	● Investigating ● Generalizing ● Relating ● Exploring

Strand E: Data Management and Probability

Competencies for Class VI

1. Demonstrate the ability to evaluate sampling results and describe that larger samples generally produce more reliable probabilities.

2. Demonstrate the ability to represent data in various formats and interpret the data.
3. Demonstrate the ability to plot coordinates in all four quadrants of coordinate graphs.
4. Demonstrate the ability to describe theoretical probability and relate it with decimal, percentage, and ratio.

Learning Objectives	Content	Process/ Essential Skills
- Identify the situation/problem. - Formulate tools (Interview/questionnaire/docum ent record/ observations) to collect data. - Generate samples avoiding bias.	VI-E1 Data Collection and Handling	- Identifying - Formulating - Generating - Collecting and Recording
- Explain and calculate mean, mode and median. - Find the missing value when the mean and other data are given. - Create the set of data from the given mean - Organise data in groups with intervals.	VI-E2 Data Organizing and Describing Central Tendencies	- Identifying - Organizing - Computing
- Construct line graphs from collected data. - Describe that the purpose of a line graph is to focus on trends implicit in the data (e.g. for temperature). - Construct and interpret bar graphs and double bar graphs using intervals. - Display the data using stem and leaf plot.	VI-E3 Data Representati on Line graph, bar & double bar graph, stem and leaf plot	- Constructing - Interpreting - Representing - Reasoning - Analysing - Computing
- Explain the application of coordinate graphs (describing location and in navigation). - Plot ordered pairs in all four quadrants of coordinate graphs using appropriate labels and scales.	VI-E4 Plotting Coordinates	- Evaluating - Constructing - Plotting - Interpreting

● Use an ordered pair of vertices of a given polygon to draw on a coordinate graph. ● Apply coordinates in real life problems such as in chess board.		
● Define theoretical probability and apply it to solve simple theoretical probability problems. ● Create an event to describe theoretical probability. ● Use percentage and decimals to describe probabilities.	VI-E5 Determine Theoretical Probability	● Describing ● Conceptualising

Class VII

Strand A: Numbers and Operations

Competencies for Class VII

1. Investigate and deduce the divisibility rules from 2-12 to apply in appropriate situations.
2. Understand the concepts of common multiples, least common multiples, common factors and greatest common factors and apply to solve relevant real-life problems.
3. Understand the number systems to represent and convert numbers in standard, expanded and exponential forms.
4. Explore and understand different strategies of decimal multiplication and division to apply accordingly in problem situations.
5. Demonstrate understanding of the concept of fractions and apply different strategies to compare and order fractions, pictorially and symbolically.
6. Explore various strategies to add and subtract fractions to apply while solving real-world problems related to fractions.
7. Use the concepts of ratio, rate and percent to solve real-life problem situations.
8. Understand the concept of integers through representation and apply it to compare and order integers pictorially or symbolically.
9. Investigate different strategies to add and subtract integers and apply them in real-life situations.

Learning Objectives	Content	Process/ Essential Skills
- Explore divisibility rules using models (e.g. base 10 block) focusing on how the rules work. - Investigate the divisibility test rules from 2 to 12. - Apply divisibility rules in mental calculations and also relate to real life situations.	VII-A1 Divisibility Test Develop and apply divisibility rules from 2 to12.	- Exploring rules - Applying

• Recall the procedure to list down common multiples and common factors. • Apply various methods (Prime Factorization, listing the multiples and repeated division) in developing LCM. • Apply various methods (Prime Factorization, listing the factors and division) in developing GCF. • Implement the concept of LCM and GCF in real life situations.	VII-A2 Lowest Common Multiple VII-A3 Greatest Common Factor	• Exploring • Applying concept of LCM • Applying concept of GCF
• Represent repeated multiplication as power with base and exponent • Recognize exponents as a means of expressing factors in a compact form. Connect "squared" with an area of a 2-D object and "cubed" with a volume of a 3-D object. • Interconvert numbers in standard, expanded and exponential form • Connect expanded forms of numbers to digits in the place value chart.	VII-A4 Powers Expanded, Standard and Exponential forms.	• Representing • Connecting • Converting
• Multiply and divide decimals pictorially and symbolically • Apply multiplying and dividing decimals in real life situations. • Apply order of operations to problems related to the four operations in decimals.	VII-A5 Decimal Operations Multiplying Decimal. Dividing Decimal. Order of Operations.	• Converting • Connecting • Applying
• Arrange fractions on a number line to compare and order them.	VII-A6 Fractions Comparing and	• Representing • Comparing

- Compare fractions relative to benchmarks, common denominator, the common numerator and decimal equivalents - Convert fractions to decimals and vice versa (terminating decimals and recurring decimals) - Introduce the terminology "repeating" and "period" as well as bar notation to show repeated decimal (up to 2-digit repeating decimals) - Use estimation before carrying out any operations. - Add and subtract fractions pictorially and symbolically (Recall concept of LCM to add and Subtract Fractions).	Ordering Fractions/ Adding and Subtracting Fractions. Relating Fractions and Decimals.	- Converting - Relating - Estimating
- Comprehend ratio as the comparison of numbers or quantities in the same units. - Comprehend rate as the comparison of two quantities with different units. - Solve problems involving ratios and rates. - Recognize percent as a special ratio - Relate visual and symbolic representation of percent. - Relate percent to fraction and decimal equivalent. - Estimate and calculate percent for familiar fractions pictorially and symbolically. - Use a variety of strategies to calculate percent.	VII-A7 Ratios, Rates and Percent Solving Ratio problems. Solving Rate problems. Represent Percent as a special Ratio. Relating Percent, Fractions and Decimals. Estimating and calculating Percent.	- Applying - Relating - Estimating - Strategizing

Learning Objectives	Content	Process/ Essential Skills
- Develop an understanding of the need to introduce integers. - Represent integers in a variety of ways (number line and counters) - Compare and order integers using different strategies. - Recognize the balance of positive and negative values based on the zero property - Add and subtract integers pictorially (number line and counters) and symbolically - Relate integers to real life context (calculating time zone, temperature)	VII-A8 Integers Develop the meaning of Integers. Comparing and Ordering Integers. Adding and Subtracting Integers.	- Representing - Comparing and Ordering - Adding and Subtracting Integers

Strand B: Patterns and Algebra

Competencies for Class VII

1. Represent patterns as linear algebraic expressions and simplify expressions to solve everyday problems.

2. Apply linear equations using various strategies (models and inverse operation) in relevant fields.

Learning Objectives	Content	Process/ Essential Skills
- Develop an understanding of constants, variables, coefficients, expressions and equations. - Use pictures, series of numbers, table of values and explore patterns rules to make predictions. - Create algebraic expressions from given words and vice versa.	VII-B1 Patterns and Relations Using variables to describe pattern rules. Creating and evaluating Expressions. Simplifying Expressions.	- Exploring rules - Applying - Comprehending - Analysing

● Evaluate expressions visually using algebraic tiles. ● Explore patterns in nature and your immediate environment.		
● Realise the differences between an equation and an expression. ● Model and solve equations using algebraic tiles. ● Recognise an equation maintains balance on both sides and solve it using inverse operations. ● Explore the relevance of linear equations in real life applications.	VII-B2 Solving Single Variable Linear Equations Solving Equations using Models. Solving Equations using Inverse Operations.	● Modelling ● Applying ● Comprehending ● Identifying

● Construct the axes as two number lines that are perpendicular to each other, intersecting at the origin
● Use a table of values for graphing
● Interpolate and extrapolate on a graph.
● Determine if an ordered pair satisfies a given equation
  o by plotting the points to see if they are keeping with the rest of the points in the pattern
  o by substituting them into the equation to see if they make the equation true or false
● Construct a graph to describe a change on a graph.
● Evaluate single variable expressions by substituting a variable in the expression.
	VII-B3 Graphical Representation
	
	Examining a straight line Graph.
	Describing a change on a graph.
		● Applying
		● Comprehending
		● Determining
		● Evaluating

● Create a straight line graph related to daily life.		

Strand C: Measurement

Competencies for Class VII

1. Understand the relations and convert SI units from one to another unit and vice versa in real life contexts.
2. Confirm relations to calculate the perimeter of regular and irregular polygons through investigation and apply in the real life situations.
3. Explore relations to calculate the area of regular polygons (up to quadrilaterals) through investigation and apply in related problems.
4. Conclude that the value of π is a ratio of circumference to the diameter of the circle.
5. Deduce the formula to calculate the circumference of a circle and apply it to related problems.

Learning Objectives	Content	Process/ Essential Skills
● Identify, use, and convert SI units (metre, litre and gram) to measure, estimate, and solve problems ● Determine the special relationship between volume, capacity and mass ● Explore and convert common imperial units into metric units.	VII-C1 SI Units	● Converting units ● Applying Metric Units ● Estimating
● Investigate the perimeter of a regular polygon ● Calculate the perimeter of irregular polygon and composite shapes.	VII-C2 Perimeter of Polygons and Composite Shapes	● Investigating ● Computing ● Manipulating

• Explore the relations (formula) to calculate the area of quadrilaterals (rectangle, square, parallelogram, rhombus, trapezoid and kite) • Solve problems involving the area of composite shapes (mm^2, cm^2, m^2, km^2, hectare) by breaking into familiar shapes (triangle and quadrilaterals)	VII-C3 Area of Quadrilaterals and Composite Shapes	• Investigating • Computing • Manipulating
• Relate diameter, radii, circumference to solve problems • Record the value of Circumference and diameter for a number of circles through measurement to investigate the value of π. • Develop the formulas for C = πd and C = 2πr • Compute lengths of different parts of a circle (semicircle and quadrants).	VII-C4 Circumference of a Circle	• Investigating • Constructing logical argument • Estimating

Strand D: Geometry

Competencies for Class VII

1. Establish relationships between angles and side lengths of triangles to investigate their relations.
2. Demonstrate an ability to construct and bisect angles to further construct other angles.
3. Apply the properties of transformation to transform regular polygons through translation, reflection and rotation.
4. Draw regular 3D shapes in 2-D design to represent concrete structures made from cubes.

Learning Objectives	Content	Process/ Essential Skills
- Conclude through investigating models that the sum of the interior angle of a triangle is always 180°. - Investigate to establish relationships in a triangle between the longest side & the largest angle. - Investigate to establish relationships in a triangle between the shortest side & the smallest angle.	VII-D1 Angle Relationships Angles in a Triangle. Relationship between the side and angles of a triangle.	- Investigating - Modelling
- Construct 30°, 45°, 60°, 90°, 120° and 180°. - Bisect angles and create new angles after bisecting.	VII-D2 Constructing and Bisecting Angles	- Constructing - Bisecting
- Use formal language: translations, reflections, and rotations for slides, flips and turns - Deduce the properties of transformation and apply transformations (Rotation, reflection and translation). - Use tessellations as a context for transformations and create art-related designs using translations, reflections, and rotations	VII-D3 Properties of Transformations Translations Reflections Rotations	- Translating - Reflecting - Rotating - Creating designs
Draw 3-D shapes to interpret its representation in 2-D design	VII-D4 Isometric Drawings Make and	- Drawing - Constructing shapes

Learning Objectives	Content	Process/ Essential Skills
● Justify the efficiency of 2-D design by observing isometric drawing that larger 3-D shapes can be accommodated in smaller space.	interpret drawings of shapes made from cubes	● Interpreting

Strand E: Data Management and Probability

Competencies for Class VII

1. Collect and organise data to describe and interpret through central tendencies and different graphs.
2. Calculate theoretical and experimental probability of events to predict and match with real & natural events.

Learning Objectives	Content	Process/ Essential Skills
● Collect data through appropriate data collection tools as an approach to solve real life problems. (Questionnaire/ interview/observation). ● Discuss sampling and bias while collecting data. ● Regroup the data in ascending order and construct stem and leaf plot ● Organise the collected data in a grouped frequency distribution table. ● Identify appropriate situations to construct histogram and to interpret it. ● Calculate central tendencies (**mean**, **median** and **mode)** and data range	VII-E1 Data Handling Collecting data • Questionnaire • Observations • Interview Representing data • Histograms • Stem and leaf plot Describing and Analysing Data. Mean, Median and mode.	● Collecting data ● Organising data ● Calculating ● Creating

• Match events that might be associated with a particular theoretical probability. • Deduce that theoretical probability of equally likely events as $$P(E) = \frac{Number\ of\ favourable\ outcome}{Total\ number\ of\ possible\ outcomes}$$ • Calculate theoretical probability for both single and double experiments (only for equally likely independent events). • Conduct experiments to determine experimental probability and compare with their theoretical probabilities.	VII-E2 Probability Describe Theoretical Probability. Matching Events and Probability.	• Computing • Matching

Class VIII

Strand A: Numbers and Operations

Competencies for Class VIII

1. Develop the meaning of negative exponents to compare and convert the exponential form to standard or expanded form and vice versa (base 10).

2. Flexibly move between numbers in scientific notations and standard form to compare very large numbers/ very small numbers and understand the role of scientific notation.

3. Recognize square numbers and calculate their square roots to apply concepts in solving real life problems.

4. Understand the concept of proportion and percent to apply and solve real life problems.

5. Explore and understand the basics of consumer mathematics and effectively apply them in real life situations.

6. Understand the fundamentals of operating integers and logically apply the process in multiplying and dividing Integers using various strategies.

7. Demonstrate the ability to identify rational numbers, multiply and divide fractions pictorially/symbolically and apply the essentials for order of operations to seamlessly apply in solving related real world problems.

Learning Objectives	Content	Process/ Essential Skills
● Develop concept of negative exponents through patterns using place value charts (tenths, hundredths, thousandths... as 10^{-1}, 10^{-2}, 10^{-3}) ● Investigate and relate negative exponents 10^{-1}, 10^{-2}, 10^{-3} to multiplying by 0.1, 0.01, and 0.001. ● Use base as 2 OR 3 with different negative exponents and write them as their equivalent fraction;($2^{-1} = \frac{1}{2}$, $3^{-2} = \frac{1}{9}$,etc) to show the concept of exponential growth). ● Convert exponential form (including negative exponent) to standard and expanded form and vice versa.	VIII-A1 Negative Exponents	● Identifying patterns ● Applying
● Convert numbers from standard form to scientific notation and vice versa. ● Compare numbers written in scientific notation as applied in real life situations.	VIII-A2 Scientific Notations	● Relating ● Converting numbers ● Justifying

• Identify each of the perfect squares from 1 through 400 using factors, or prime factorization or observing digits in one's place. • Demonstrate that the differences in perfect squares follow a pattern. • Show that the sum of the square roots of two consecutive perfect squares is equal to the difference between those two perfect squares • Approximate which whole number is closer to the square root of non-perfect squares. • Estimate and calculate the square root of the larger number. • Apply prime factorization to calculate square roots. • Calculate square root using square root algorithm.	VIII-A3 Perfect Squares Interpreting Square Root. Estimating and Calculating Square roots.	• Identifying • Relating • Representing • Approximating • Applying
• Apply the concept of terms *means and extremes* and calculate missing values in proportions following the norm that product of means is equal to product of extremes • Explore and solve problems related to proportion using a variety of strategies. • Use different strategies to solve percent greater than 100. • Solve problems involving fractional percents	VIII-A4 Proportion and Percent Solving Proportions. Percent greater than 100. Solving Percent Problems. Fractional percent.	• Relating • Applying • Connecting
• Investigate and identify cost price, selling price, mark-up and	VIII-A5	• Investigating • Applying

discount/ Markdown through the problem situation and calculate selling price, Mark-up/Markdown amount. • Apply formula to calculate percent increase / percent decrease (Mark-up % or Markdown %). • Explore and solve simple problems related to simple interest and commission.	Consumer Problems Mark-up and Discount Simple Interest Commission	• Connecting
• Multiply and divide integers pictorially and symbolically. • Estimate to check the reasonableness of results • Apply properties for multiplying integers such as Commutative (order), Associative (grouping) and Distributive properties	VIII-A6 Integers Multiplying Integers. Dividing Integers.	• Estimating • Applying
• Construct concrete or pictorial model of fractions to develop meaning • Multiply and divide fractions pictorially and symbolically • Define and identify rational numbers. • Apply order of operations to problems related to rational numbers.	VIII-A7 Fractions and Rational Numbers Multiplying and Dividing Fractions. Rational Numbers Order of Operations.	• Comparing • Relating • Estimating • Applying

Strand B: Patterns and Algebra

Competencies for Class VIII

1. Describe relationships using words, expressions and equations to represent patterns given in tables, graphs or charts, pictures and problems in real life situations.

2. Use the concept of linear equations and apply them in solving real life problems algebraically and graphically.

3. Demonstrate the ability to add and subtract polynomials using various strategies (pictorially and symbolically) and apply the concept in real life situations.

Learning Objectives	Content	Process/ Essential Skills
● Describe in words and use expressions and equations to represent patterns given in tables, graphs or charts, pictures and problem situations. ● Use the information presented in a variety of formats to derive Linear mathematical expressions and predict unknown values ● Identify linear relationships from derived expressions ● Sketch graphs for a variety of situations leading to linear graphs	VIII-B1 Describing Relationships and Patterns	● Connecting ● Applying ● Predicting ● Describing
● Create and solve relevant problems for which algebraic solutions are required using concrete or pictorial models and algebraic representations. ● Determine the solution for two linear equations graphically and algebraically ● Define and calculate slope through various strategies. ● Investigate slope in practical situations. (eg: slope of a staircase, slope of a roof, and the steepness of roads.	VIII-B2 Solving Linear Equations Using an equation to solve a problem. Solving problems involving two relationships graphically and algebraically Slope	● Creating ● Applying ● Identifying ● Representing ● Comprehending ● Investigating ● Determining ● Comparing

● Add and subtract polynomials pictorially using algebra tiles or symbolically. ● Use Zero property for adding and subtracting polynomials.	VIII-B3 Linear Polynomial Adding and Subtracting Polynomial	● Applying ● Representing

Strand C: Measurement

Competencies for Class VIII

1. Explore and understand the concept of Pythagorean Theorem to apply and solve real life problems.
2. Understand and examine the relationship between area and perimeter (up to quadrilaterals) and apply the concept to solve real world problems.
3. Explore and examine the concept of volume and surface area of rectangular prisms and apply to solve real life problems.
4. Determine the relation to calculate the area of a circle and its parts (semi-circle and quadrants) to apply in solving related problems.

Learning Objectives	Content	Process/ Essential Skills

● Prove, through investigation, that if a square is made on each side of a right triangle, the sum of the area of two smaller squares will be equal to the area of the square on the longer side.
● Explore various Pythagorean triplets
● Apply Pythagorean Theorem
  o to calculate the length of the hypotenuse, as well as length of the other side when the hypotenuse and one side is given
  o to find distance between two points in real life situations
	VIII-C1 Pythagorean Theorem
	
	Applying Pythagorean Theorem
		● Investigating relationships
		● Constructing logical argument

(e.g. determine the reach of a ladder).		
• Calculate the area (Triangles and quadrilaterals). and perimeter of 2-D shapes. • Investigate that area can vary when perimeter is fixed • Investigate that perimeter can vary when the area is fixed	VIII-C2 Area and Perimeter Relationships	• Investigating • Analysing
• Investigate that the volume of a rectangular prism is the area of its base multiplied by its height. • Identify appropriate units while finding volume and capacity in a given situation. • Compare the size of an object by comparing their volumes. • Estimate before calculating dimensions. • Use nets of a rectangular prism to deduce the formula to calculate total surface area (TSA) and apply it in related problems. • Investigate changes in total surface area based on changes in dimensions • Calculate the missing side length of a rectangular prism when total surface area or volume, and other two side lengths are given.	VIII-C3 Volume and Surface area of a Rectangular Prism	• Analysing • Investigating • Relating • Applying
• Explore various ways to conclude the formula for the area of the circle.	VIII-C4 Area of a Circle	• Investigating • Applying • Estimating

● Compute area of a circle, semi circles and quarter circles(quadrants). ● Use the formula for area of the circle to determine the radius when the area is given.		

Strand D: Geometry

Competencies for Class VIII

1. Demonstrate understanding of dilation of 2-D shapes and apply to transform regular polygons through combined transformations.
2. Deduce rules to calculate interior and exterior angles of regular polygons and apply it to solve related problems in real life situations.
3. Construct and draw triangles appropriately exploring different ways when side lengths and angles are given.
4. Investigate angles when parallel lines are cut by a transversal to find the relation between various angles formed and apply the concept in finding angles in figures without measuring.
5. Represent face views of regular 3-D shapes in 2-D design to visualise their spatial movement.

Learning Objectives	Content	Process/ Essential Skills
● Explain dilation as enlargement or reduction of a shape based on scale factor. ● Investigate dilations of 2-D objects by applying different scale factors ● Analyse how an object dilates based on the position of its dilation centre using relevant software. ● Explore combinations of transformations that include dilations, such as an	VIII-D1 Transformation Dilations. Combining Transformations.	● Transformin g shapes ● Analysing

enlargement/reduction followed by a reflection/rotation /translation and vice versa.		
● Develop a relationship through investigation, to find the sum of the interior and exterior angles of a polygon. ● Apply the relationship to calculate the sum of the interior angles and the measure of each interior angle in a regular polygon. ● Draw and Construct triangles appropriately using given side length and angle(s).	VIII-D2 Angles in a Polygon	● Investigating ● Generalising ● Applying ● Constructing
● Investigate how angles change when a pair of lines are cut by a transversal line. ● Determine the relationship between corresponding angles and alternate angles when a transversal intersects a pair of parallel lines. ● Apply transformational geometry to discover why the various angle pairs are equal.	VIII-D3 Angles in Parallel and Intersecting Lines	● Identifying ● Applying ● Analysing
● Apply prior interpretation knowledge of 2-D pictures to enhance the mathematical experience with 3-D objects. ● Construct structures from isometric drawings in various face views.	VIII-D4 Representing Objects Isometric Drawing. Orthographic Drawing.	● Representing ● Visualising

Create orthographic drawings of 3-D figures, apply the skill to make structure using linking cubes from a given set of orthographic plans or drawings. Compare isometric plans and orthographic face views		

Strand E: Data Management and Probability

Competencies for Class VIII

1. Demonstrate the understanding of the data collection process and implement it to collect, organise, represent and interpret data.
2. Calculate theoretical probability of events to find complementary events.

Learning Objectives	Content	Process/ Essential Skills
- Generate samples using random sampling avoiding bias for fairness while collecting data. - Collect data using developed tool(s) as a process to solve problems identified. - Organise the collected data in tabular form. - Represent the collected data in a circle graph and make comparative analysis. - Decide when a circle graph is the most appropriate representation to display data. - Display the data in histogram. - Compare and contrast histogram and circle graph to show data can be represented in multiple ways.	VIII-E1 Data Handling Collecting data o Questionnaire o Observations o Interview Representing Data Data Analysis	- Collecting - Organizing - Representing - Analysing

• Calculate theoretical probability of equally likely events $$P(E) = \frac{Number\ of\ favourable\ outcomes}{Number\ of\ possible\ outcomes}$$ • Define complementary events. • Deduce that probability of a complementary event is calculated using 1−P(E) and show that P(E) + P (not E) = 1	VIII-E2 Probability Describe Complementary Events. Calculating Theoretical Probability of events and complementary events.	• Computing • Analysing

Class IX

Strand A: Numbers and Operations

Competencies for Class IX

1. Deduce and apply the exponent laws for positive, negative and fractional powers to solve related problems.

2. Evaluate the meaning of real numbers through their representations and operations to apply in our everyday understanding of numbers.

3. Demonstrate understanding of sets through their representations and operations to apply in sorting of data in real life.

4. Use ideas of income to calculate taxation and evaluate interests as a way of saving money.

5. Solve problems related to day to day buying and selling situations to evaluate purchasing decisions.

Learning Objectives	Content	Process/ Essential Skills
• Demonstrate an understanding of the law of exponents in solving relevant problems. • Apply the following exponent	IX-A1 Exponent Laws: Integral Exponents	• Applying • Analysing • Reasoning

rules/laws: ○ $a^m \times a^n = a^{m+n}$ ○ $a^m \div a^n = a^{m-n}$ ○ $(ab)^n = a^n b^n$ ○ $\left(\dfrac{a}{b}\right)^n = \dfrac{a^n}{b^n}$ ○ $\left(a^m\right)^n = a^{mn}$ ○ $a^0 = 1$ ○ $a^{-n} = \dfrac{1}{a^n}$ ○ $a^{\frac{1}{2}} = \sqrt{a}$ ○ $a^{\frac{1}{n}} = \sqrt[n]{a}$ ○ $a^{\frac{m}{n}} = \sqrt[n]{a^m}$	Introducing the Exponent Laws. The power law of Exponents. Negative and Zero Exponents. Fractional Exponents.	
● Justify if a given number is rational or irrational. ● Place irrational numbers on a number line relative to known rational numbers. ● Demonstrate that the set of real numbers includes both rational and irrational numbers. ● Apply knowledge of order of operations on rational numbers.	IX-A2 Rational, Irrational and Real Numbers Meaning of Rational, Irrational and Real Numbers. Order of Operations. Representing Real Numbers.	● Applying ● Reasoning ● Evaluating
● Use set language and notation to describe sets of numbers, shapes, objects, etc. ● Represent sets using Venn diagrams and carry out different operations on sets (union, intersection and complementary). ● Apply set theory to solve problems in real life context.	IX-A3 Set Theory Use set language and notation. Types of sets. Representing the set using	● Applying ● Classifying ● Representing

Learning Objectives	Content	Process/ Essential Skills
- Explain income and explore various ways to earn money. - Estimate and calculate deductions from income. - Estimate and calculate taxes on income using a tax slab. - Calculate simple interest, rates, time, principal and amount. - Solve problems involving purchases using the idea of percentage.	the Venn diagram.	
	IX-A4 Commercial Mathematics Sources of income. Income deductions. Simple interest. Purchasing Decisions.	- Reasoning - Applying - Analysing

Strand B: Patterns and Algebra

Competencies for Class IX

1. Demonstrate understanding of polynomials through their classifications and representations to operate polynomials pictorially and symbolically.

2. Classify linear from non-linear relations and demonstrate the properties of linear relations in its two forms through a table of values, graphical representations, and equations.

3. Evaluate the nature of data (discrete/continuous) from a scatter plot and use interpolation/extrapolation to draw conclusions and predict trends.

4. Solve linear equations and linear inequalities graphically and algebraically to investigate polynomial behaviour.

Learning Objectives	Content	Process/ Essential Skills
- Interpret and classify different types of polynomials. - Add and subtract polynomials pictorially and symbolically. - Multiply pictorially and symbolically: a polynomial by a monomial, multiply a binomial by a binomial and a monomial by a	IX-B1 Polynomial Expressions Model polynomial expressions. Interpreting polynomials.	- Applying - Analysing - Comprehending - Understanding

scalar, a polynomial by a scalar. ● Divide pictorially and symbolically: monomial by a monomial; polynomial by a scalar; polynomial by a monomial.	Adding and subtracting Polynomials. Multiplying polynomials. Dividing polynomials.	
● Describe verbally, symbolically, patterns given in tables, charts, pictures, and by problem situations. ● Explain why the data in a table represents a linear, quadratic, or exponential relationship. ● Derive the formula of slope from the graph as rise/run (rise the vertical change, and run the horizontal change) and relate the y-intercept to the value of the y-coordinate where the graph crosses the y-axis. ● Determine the slope and y-intercept by examining a table, graph, or equations. ● Determine the two forms of linear equations: (y = mx+b) given the slope (m) and y-intercept(b), and standard form (ax + by = c). ● Distinguish between independent and dependent variables in a scatter plot to identify if the data represented are continuous or discrete. ● Demonstrate how interpolation and extrapolation using a line of best fit is meaningful for a given set of real life data.	IX-B2 Linear and Non-Linear Relations and Graphs Patterns and relations in tables. Graphs of linear and non- linear relations. The meaning of slope and y-intercept. Representing slope and y-intercept and standard form. Scatter plots of discrete and continuous data. Line of Best Fit.	● Applying ● Analysing ● Modelling ● Representing

• Solve linear equation problems graphically and algebraically. • Represent inequality using symbols of inequality and solve linear inequalities algebraically. • Describe inequalities using graphs. • Explore graphing for given information in a variety of formats using MS Excel/ GeoGebra/ Graphmatica and others.	IX-B3 Linear Equations and Inequalities Solving linear equations algebraically and graphically. Solving linear Inequalities. Graphs of Linear Inequalities.	• Analysing • Representing • Graphing • Computing

Strand C: Measurement

Competencies for Class IX

1. Demonstrate understanding of properties and measures of precision and accuracy to evaluate and enhance the credibility of a measurement.
2. Verify 2-D efficiency inductively to apply properties of 2-D efficiency in real life situations.
3. Use appropriate properties of triangles to determine the basic trig-ratios in right angled triangles and use the ratios to deduce trigonometric identities.
4. Demonstrate the application of trigonometry to deduce relations and calculate areas of polygons and heights and distances in real life context.

Learning Objectives	Content	Process/ Essential Skills
• Demonstrate understanding that precision depends on how finely an instrument is calibrated (or graduated) (e.g. measuring length using cm ruler or mm ruler). • Demonstrate understanding that accuracy depends upon how correctly the measurement is taken. • Express measurements using significant figures.	IX-C1 Precision and Accuracy Comparing precision and accuracy Counting significant figures	• Estimating • Analysing • Reasoning

• Understand the meaning of efficiency of any 2-D shape. • Examine maximising area while restricting perimeter and examine minimising perimeter while restricting area. • Explore efficiency design of 2-D shapes.	IX-C2 Properties of 2-D Efficiency Exploring 2-D efficiency	• Communicating • Evaluating • Applying
• Develop primary trigonometric ratios applying properties of similarity and side-angle relationships. • Use calculators to determine the trig ratios sin θ, cos θ, and tan θ. • Use the sine and cosine ratios to articulate the relationships between the sides and angles of a triangle. • Prove the trigonometric identities and apply in appropriate situations. • Explore angles of elevation (measured from the horizon up) and angles of depression (measured from the horizon down) in real world settings. • Find areas of polygons using trigonometric ratios.	IX-C3 Trigonometry The sine, cosine, tangent ratios and their reciprocals. Trigonometric identities. Angles of elevation and angles of depression. Areas of polygons.	• Applying • Analysing • Classifying • Representing

Strand D: Geometry

Competencies for Class IX

1. Analyse measures of sides and angles to evaluate the properties of congruence and similarity of triangles to solve real life based problems.
2. Demonstrate the interpretation of transformations using mapping notations to graphically represent dynamics of transformations on a coordinate plane.

Learning Objectives	Content	Process/ Essential Skills
- Demonstrate understanding of the meaning of congruence and similarity. - Examine the conditions necessary for congruence and similarity. - Compare and contrast congruence and similarity as they relate to triangles. - Solve problems based on real life context related to congruence and similarity by applying related properties.	IX-D1 Congruence and Similarity of Triangles Congruent triangles Similar triangles. Solving problems with Similarity.	- Applying - Analysing - Evaluating
- Apply translation, reflection, rotation, and dilation to shapes on the coordinate plane using mapping notation. - Describe the nature of a transformation based on a given mapping notation. - Evaluate the series of transformations when image and the preimage are given. - Use graphing software to explore the characteristics of transformations	IX-D2 Transformations Translations. Reflections and Rotations Dilations.	- Applying - Reasoning - Evaluating

Strand E: Data Management and Probability

Competencies for Class IX

1. Apply appropriate methods of data representation for a set of real life based ungrouped data collected to evaluate the data distributions and draw conclusions.
2. Demonstrate an understanding of the properties of the various methods of displaying data to evaluate and correct misleading features.

3. Determine Experimental probability and Theoretical probability of an event to evaluate their differences based on randomness in real life context.
4. Use outcome charts (space diagrams) and tree diagrams to determine the theoretical probabilities of individual and/or two independent events.

Learning Objectives	Content	Process/ Essential Skills
- Compute the 5 number summary for a given set of ungrouped data. - Identify and explain the basic steps of Data Management. - Determine, discuss and justify, why a particular display is suited to a specific type of data, or to a given context or purpose. - Use relevant software (such as MS Excel, Graphmatica, GeoGebra, etc.) to display data. - Compare various methods of displaying data. - Draw inferences and conclusions from a number of data displays. - Identify and explain the features that might mislead the graphs.	IX-E1 Collecting, Displaying and Analysing Data Collecting data. Displaying data using Stem and leaf Plot (single and double). Box and whisker plot. Circle Graph. Bar Graph. Histogram. Analysing Data. Misleading Graph.	- Collecting data - Displaying data appropriately - Applying - Analysing - Representation
- Relate the experimental probability of an event with the theoretical probability for that event. - Determine the number of possible outcomes for independent events using outcome charts and tree diagrams. - Define independent events with examples and reasoning. - Calculate probabilities of independent events; *P(A) x P(B) = P(A and B).*	IX-E2 Probability Determining and comparing probabilities. Randomness: experimental versus Theoretical results. Calculating Probability of Two	- Computing - Applying - Reasoning - Analysing

	Independent events.	

Class X

Strand A: Numbers and Operations

Competencies for Class X

1. Demonstrate the understanding of properties of radicals in relation to rational numbers, and perform arithmetic operations on radicals.

2. Evaluate properties of matrices to classify into different types and use operations on matrices to apply to real life situations.

3. Interpret digraphs to matrices and use the relation to solve real life based network problems involving one-stopover and/or two-stopover trips.

4. Solve situational problems on simple and compound interests, dividends and stocks to evaluate better money making options.

Learning Objectives	Content	Process/ Essential Skills
• Relate radicals with irrational numbers. • Convert an entire radical to mixed radical and vice versa. • Perform basic arithmetic operations on radical expressions.	X-A1　Radicals Simplifying Radicals. Operation with Radicals.	• Estimating • Analysing • Computing
• Describe matrices and identify the parts of the matrix (e.g. row, column, dimension, location and element). • Classify types of matrices (square matrix, column matrix, row matrix, identity matrix). • Justify inductively if two matrices can be added, subtracted, or multiplied by checking the orders of the matrices. • Apply operations on matrices (addition, subtraction and	X-A2 Matrices Introducing matrices. Adding and subtracting Matrices. Multiplying a matrix by a scalar. Multiplying matrices.	• Conceptualising • Reasoning • Computing • Applying • Analysing

multiplication) in problem situations. ● Represent a network as a matrix and interpret a matrix in terms of a corresponding network situation.	Describing a network with a matrix.	
● Demonstrate understanding of the long term difference between simple and compound interest. ● Investigate both investments and financing situations. ● Solve problems related to dividends and stocks using concepts of dividend, stock, dividend rate, face value, market value and yield percentage.	X-A3 Commercial Mathematics Dividends and Stocks. Simple and Compound Interest.	● Conceptualising ● Applying ● Reasoning ● Describing

Strand B: Patterns and Algebra

Competencies for Class X

1. Identify properties of relations and functions to classify through algebraic expressions, word statements, tables of values and graphs.

2. Devise applications of linear functions and its graphical representations to interpret and solve real life problems.

3. Demonstrate graphical and algebraic solutions to a system of linear equations and apply its interpretation to real life contexts.

4. Use graphs of quadratic functions to interpret real life situations and correlate the graphical solutions to the real life contexts.

5. Demonstrate factorization of non-linear equations to determine their roots and/or solutions, and to apply their interpretation in solving real life problems.

Learning Objectives	Content	Process/ Essential Skills
● Demonstrate an understanding of a relation and a function through examples.	X-B1 Linear Functions and Relations	Applying ● Graphing ● Reasoning ● Communicati

• Convert equations of line from one form to another (slope and y-intercept form to standard form and vice versa). • Devise applications of linear functions in real life situations. • Create graphs for given information in a variety of formats using MS Excel/ GeoGebra/ Graphmatica and others.	Linear functions. Applications of Linear Functions.	ng
• Demonstrate graphical solutions for a system of linear equations. • Analyse a variety of situations and model them into algebraic equations. • Solve systems of linear equations by comparison method/ substitution method/ elimination method and relate to the real life contexts.	X-B2 Solving Systems of Linear Equations Solving systems graphically Solving Algebraically using: o The comparison strategy o The substitution strategy o The elimination strategy	• Applying • Graphing • Reasoning • Communicating
• Classify and interpret the three forms of quadratic functions to evaluate if they are equivalent functions. • Sketch the graph of quadratic functions in standard, factored, and	X-B3 Graphs of Quadratic Functions Forms of Quadratic Functions. Graphs of	• Computing • Applying • Recognizing • Creating

Learning Objectives	Content	Process/ Essential Skills
vertex form and graphically solve related real life problems. ● Transform quadratic functions in standard and vertex form into mapping notations and vice versa to represent the function graphically. ● Create an equation from the graph of quadratic function.	quadratic Functions in factored form. Relating graphs of Quadratic functions.	
● Develop factoring strategies for polynomials in one variable that are products of binomials (degree one). ● Use the roots (x-intercepts) to determine the solutions of quadratic equations and apply its interpretation to real life contexts.	X-B4 Solving Non-Linear Equations Factoring quadratic Expressions. Solving quadratic Equations by factoring.	● Strategize ● Applying ● Analysing

Strand C: Measurement

Competencies for Class X

1. Calculate surface area of prisms, cylinders, pyramids, cones and spheres and relate to the composite 3-D shapes around us.
2. Calculate volume of prisms, cylinders, pyramids, cones and spheres and relate to the composite 3-D shapes around us.
3. Verify 3-D efficiency inductively and apply properties of 3-D efficiency in real life situations.
4. Use degrees and radians as measures of angles to demonstrate understanding of trigonometric functions (types, sign conventions, magnitude, periods) and to apply in different contexts.

Learning Objectives	Content	Process/ Essential Skills

• Calculate the surface area of a variety of 3-D shapes.
• Solve problems related to finding:
  o surface area when dimensions are given.
  o unknown dimension when surface area is given.
  o Calculate surface area of real life based composite shapes using appropriate formulas.
	X-C1 Surface Area of 3-D Shapes
	Estimate and calculate surface area of prisms, pyramids, cylinders, cones and spheres
		• Analysing
		• Applying
		• Reasoning

• Estimate and calculate the volume of prisms, cylinders, cones and spheres (memorization of formulas is not intended at this level). • Calculate volume of real life based composite shapes using appropriate formulas.	X-C2 Volume of 3-D Shapes Volume of prisms, cylinders pyramid, cones, spheres and composite shapes.	• Applying • Analysing • Reasoning
• Examine maximising volume while restricting surface area and minimising surface area while restricting volume. • Explore efficiency design of 3-D shapes.	X-C3 Properties of 3-D Efficiency Exploring 3-D efficiency	• Communicating • Evaluating • Applying
• Demonstrate the understanding of conventions of signs of angles. • Deduce the relationship between degrees and radians. • Use fundamental trigonometric relations to prove simple trigonometric identities. • Demonstrate the understanding of signs of trigonometric functions (types, sign conventions, magnitude, periods).	X-C4 Trigonometry Measuring angles in degrees and radians. Signs of trigonometric Ratios. Trigonometric ratios of	• Estimating • Applying • Reasoning • Analysing

Learning Objectives	Content	Process/ Essential Skills
● Apply t-ratios of standard angles and allied angles to solve problems. ● Examine graphs of trigonometric functions to determine periods using relevant graphing software (Geogebra).	standard and allied angles. Proving simple trigonometric identities. Graphs and periods of trigonometric functions.	

Strand D: Geometry

Competencies for Class X

1. Demonstrate properties of mirror and turn symmetry on 2-D/3-D shapes to relate to symmetry in nature around us.
2. Use bisectors, medians and altitudes to explore the different geometric centres of triangles through constructions.

Learning Objectives	Content	Process/ Essential Skills
● Demonstrate and compare mirror symmetry for 2-D and 3-D shapes. ● Use lines of symmetry to inductively verify names of regular polygons. ● Demonstrate and compare mirror symmetry for 2-D and 3-D shapes. ● Compare properties of mirror and turn symmetry for both 2-D and 3-D shapes using technology.	X-D1 Symmetry 2-D and 3-D Reflectional Symmetry 2-D and 3-D Rotational Symmetry	● Comparing ● Reasoning ● Applying ● Evaluating
● Construct perpendiculars and angle bisectors. ● Locate in-centres and circum-centres to construct incircles and circumcircles. ● Construct medians and altitudes of triangles.	X-D2 Constructions Perpendiculars and Bisectors. Circumcircle and in-circle.	● Communicating ● Constructing ● Creating ● Applying

● Locate centroids (centres of gravity) and ortho centres using medians and altitudes constructions.	Medians and Altitude	

Strand E: Data Management and Probability

Competencies for Class X

1. Apply appropriate methods of data representation for a set of real life based data (both grouped and ungrouped) collected to evaluate the data distributions, draw conclusions and predict trends.
2. Use strengths of correlations between two variables from scatter plots of real life data to draw conclusions and predict trends.
3. Differentiate and determine the theoretical probabilities for dependent and independent events and apply to both common and conditional real life events.

Learning Objectives	Content	Process/ Essential Skills
● Identify and explain the basic steps of Data Management. ● Compare various methods of displaying data which are grouped in intervals and evaluate their effectiveness: stem and leaf plots, box and whisker plots and histograms. ● Derive the 5 number summary from a grouped data to create a box plot and relate to its histogram. ● Calculate the measures of central tendencies of a grouped data. ● Predict, observe and explain how the different measures of central tendency are affected by extreme data values (or outliers) and	X-E1 Collecting, Displaying and Analysing Data Histograms and Stem and Leaf Plots. Histograms and Box and Whisker Plots. Data Distribution.	● Conceptualising ● Collecting data ● Communicating ● Applying ● Analysing ● Representing ● Reasoning ● Creating

discuss their appropriate use in different contexts. ● Demonstrate an understanding of the properties of different data distributions with relevant situational examples.		
● Demonstrate understanding that a correlation coefficient is a description of the strength of the correlation represented by a linear pattern. ● Identify the difference between a strong and weak correlation and between a negative and positive correlation based on the scatter plot and the value of the correlation coefficient. ● Explore the line and curve fitting for a scatter plot to draw appropriate conclusions.	X-E2 Data Involving Two Variables Correlation and Lines of Best Fit. Non-Linear Data and Curves of Best Fit.	● Conceptualising ● Communicating ● Reasoning ● Applying ● Analysing
● Distinguish between two events that are dependent or independent using reasoning and calculations. ● Calculate the probability of two independent events, A and B, as P(A) × P(B). ● Calculate probability of dependent and independent events.	X-E3 Probability Dependent and Independent Events. Calculating Probabilities. Calculating probability of two independent events. Calculating probability of two	● Computing ● Applying ● Reasoning ● Analysing

	dependent events.	

Class XI - Business Mathematics

Strand A: Numbers and Operations

Competencies for Class XI - Business Mathematics

1. Demonstrate the understanding of determinants and apply them to solve real-world problems involving a system of equations with two or three variables.

2. Exhibit an ability to show the relationship between logarithmic and exponential expressions, and apply the properties of exponents and laws of logarithm in solving problems.

3. Display an ability to expand expressions with positive indices using the concept of the binomial theorem.

4. Exhibit an understanding of different types of bank accounts in Bhutan and calculate its interests.

Learning Objectives	Content	Process/ Essential Skills
● Evaluate the determinant of orders two and three. ● Find the minors and cofactors of every element of a determinant. ● Examine the conditions for consistency for a system of equations. ● Solve the system of equations in two and three unknowns related to real-life scenarios.	XIB-A1 Determinants Determinant of order two and three. Minors and cofactors of determinants of order two and three. Expansion of determinants.	● Reading Comprehension ● Information Recall ● Knowledge Application ● Problem Solving

	Conditions for consistency. Solution of simultaneous equations in two and three variables.	
● Establish connections between exponent laws and logarithmic forms. ● Develop a comprehensive understanding of the meaning and concept of logarithms. ● Apply theorems and laws of logarithms proficiently to solve logarithmic problems.	XI B-A2 Logarithms Meaning of logarithm Theorems of logarithms Laws of logarithms (Exclude change of base).	● Information Recall ● Interpreting Information ● Analysing ● Problem Solving
● Understand the concepts of binomial theorem. ● Expand any binomials with positive exponents using the binomial theorem.	XI B-A3 Binomial Theorem Factorial Notation Meaning of $^{n}C_{r}$ Binomial theorem for positive indices.	● Defining key Concepts ● Information Recall ● Problem Solving ● Analysing
● Understand different types of deposit accounts - saving, fixed, current, recurring and loan. ● Compute interest on saving deposit account and fixed deposit.	XI B-A4 Banking Types of deposit accounts: saving, fixed, current,	● Conceptualising ● Applying ● Recalling Information ● Analysing

| | | recurring, and loan. | |
| | | Calculation of interests in saving bank statements and fixed deposits. | |

Strand B: Patterns and Algebra

Competencies for Class XI - Business Mathematics

1. Analyse and categorise real-life sequences as either arithmetic or geometric progressions, and address problems by utilising the concepts of nth term and the sum of n terms in a series.

2. Utilise the concept of summation notation to evaluate the sum of a series involving natural numbers.

3. Exhibit an ability to apply concepts of remainder and factor theorems in factoring quadratic and cubic polynomials.

4. Demonstrate proficiency in solving both quadratic equations and quadratic inequalities.

5. Demonstrate an ability to resolve rational fractions of different types into partial fractions.

6. Demonstrate an understanding of fundamental theorems of limits, and evaluate limits of algebraic functions.

7. Exhibit an ability to recognize the continuity of a function both theoretically and geometrically.

8. Demonstrate a comprehensive understanding of derivatives both theoretically and geometrically.

9. Exhibit proficiency in differentiating functions using the first principle and other methods, and apply these skills to solve real-life problems.

10. Demonstrate an understanding of integration as the reverse process of differentiation.

11. Display an ability to integrate functions using different methods, and apply the concept in solving real-life problems.

Learning Objectives	Content	Process/ Essential Skills
• Relate the Arithmetic and Geometric Progressions with the patterns. • Understand the concept of Arithmetic Progression (A.P) and Geometric Progression (G.P). • Find n^{th} term (T_n) of A.P and G.P. • Find the sum of the n terms of series (S_n) of A.P and G.P.	XI B-B1 Sequence and Series Finding the nth term of A.P and G.P Finding the sum of stated number of terms of A.P and G.P.	• Reading Comprehension • Information Recall • Knowledge Application • Problem Solving • Analysing
• Understand the concept of the remainder theorem, and evaluate the remainder when a polynomial is divided by a monomial. • Understand the factor theorem and factorise a polynomial using the factor theorem.	XI B-B2 Remainder and Factor Theorem Meaning of Rational Integral Function. Remainder Theorem. Factor Theorem. Factorization of quadratic and cubic polynomials.	• Conceptualising • Communication • Analysing • Reasoning • Applying • Problem Solving
• Determine the solutions of a quadratic equation using both the factoring method and the quadratic formula. • Determine the solutions of quadratic inequalities using both the factoring method and the quadratic formula.	XI B-B3 Quadratic Equations and Functions Solution of quadratic equations by the factoring and formula method.	• Conceptualising • Communication • Analysing • Evaluating • Applying • Problem Solving • Exploring

	Quadratic inequalities.	
• Comprehend the meaning and concept of rational functions in the form $\frac{f(x)}{g(x)}$. • Resolve partial fractions for proper rational fractions. • Resolve partial fractions for rational fractions with denominators containing repeating linear factors. • Resolve partial fractions for rational fractions with denominators containing quadratic factors that cannot be factored into linear terms. • Resolve partial fractions for improper rational fractions.	XI B-B4 Partial Fractions Definitions. Resolving into partial fractions: Type 1: Degree of numerator $<$ Degree of the denominator Type 2: Degree of numerator $\geq$ the degree of denominator Type 3: Non-repeated linear factors. Type 4: Repeated linear factors. Type 5: Quadratic factors not resolvable into linear factors.	• Conceptualising • Connection • Communication • Critical Thinking • Applying • Problem Solving
• Understand the meaning of limits and the fundamental theorem of limits. • Compute left-hand limit and right-hand limit to check if limit at a point exists. • Evaluate the limit of a function using direct substitution method. • Evaluate the limit of a function using the factorisation method.	XI B-B5 Limits Meaning of limits. Fundamental theorems on limits. Theorems on limits. Limits of algebraic functions by: Direct substitution,	• Conceptualising • Critical thinking • Evaluating • Analysing • Applying • Problem Solving

• Evaluate the limit of a function using rationalisation.	factorisation, rationalisation, expansion. Limits of algebraic function at infinite.	
• Understand the concept of continuity and removable discontinuity of a function theoretically as well as graphically. • Examine the continuity of the function by evaluating the right-hand limit and left-hand limit.	XI B-B6 Continuity and Discontinuity of Function Continuity of a function at a point. Removable discontinuity. Continuity in an interval.	• Analysing • Conceptualising • Applying • Information recall • Knowledge Application
• Explore the meaning of derivatives and its geometrical interpretation. • Differentiate functions using the first principle. • Differentiate the algebraic functions of any form and simple logarithmic functions $log\,(x)$ and $log(ax + b)$.	XI B-B7 Differentiation Meaning and geometrical interpretation of derivatives. Differentiation from the first principle or definition. Differentiation of algebraic functions and simple logarithmic functions: $log(x)$ and $log(ax + b)$. Differentiation of products and quotients of two	• Defining key concepts • Making Connections • Conceptualisation • Knowledge Application • Problem Solving

146

	algebraic functions using formulae. Application of derivatives.	
• Understand the meaning of integration, recognizing it as the reverse process of differentiation. • Evaluate integrals of algebraic functions using basic rules. • Integrate algebraic functions using the substitution method.	XI B-B8 Integration Indefinite integral: integration as the reverse of the process of differentiation. Anti-derivatives of algebraic functions. Integration of algebraic functions using the substitution method.	• Conceptualising • Connection • Critical Thinking • Analysing • Applying • Problem Solving • Evaluating

Strand C and D: Measurement and Geometry

Competencies for Class XI - Business Mathematics

1. Demonstrate a comprehensive understanding of the coordinate system in 2-Dimension, and apply distance, section, and midpoint formulas to describe a point and a line within a two-dimensional coordinate system.

2. Demonstrate an ability to write the equations of straight lines in different forms, and apply the concepts in solving problems related to commerce and economics.

3. Demonstrate proficiency in identifying and representing equations of circles in various forms, adeptly generating circles under specified conditions.

4. Display the ability to analyse geometric configurations involving circles and apply the theorems to deduce unknown angles, arc lengths, and other geometric properties.

5. Demonstrate the ability to engage in logical reasoning and systematically construct rigorous mathematical proofs, allowing them to present a sequence of logical arguments to establish the truth of a given theorem.

Learning Objectives	Content	Process/ Essential Skills
• Understand the meaning of the coordinate plane and the coordinates (*x*-coordinate and *y*-coordinate). • Find the distance between two points in the 2-D plane and solve related problems. • Find the coordinates of the points using distance, section and midpoint formula, and solve related problems.	XI B-CD1 Points and their Coordinates in 2-Dimension Coordinates-Definition and Notation. Distance Formula. Division or section formula: o Internal division o Midpoint formula o External division	• Conceptualising • Applying • Analysing • Creative Thinking • Information recall
• Express the equations of the straight lines in different forms: slope-intercept, point-slope, two-points and general. • Apply the concept of the equation of the straight line to find the relations between two quantities in commerce and economics.	XI B-CD2 The Straight Line General equation of a line. Derivation of the equations of a straight line: slope-intercept form, point-slope form, two-point form.	• Distinguishing differences • Defining key concepts • Knowledge application • Analysing
• Define a circle and its parts.	XI B-CD3	• Conceptualizi

● Represent the equation of a circle in standard form and solve related problems. (*Omit general and parametric forms*). ● Illustrate theorems of circles using relevant diagrams, and apply the theorems in solving logical problems related to circles.	Circle and Its Theorems Definition of circle and its parts. Equation of circle in standard form and diameter form. Terminologies related to circle theorems. Theorems on Circles: Chords of a circle. Arcs and Angles. Congruent Arcs and Chords. Tangent Lines and Circles. Angles in Alternate Segment.	ng ● Representing ● Critical Thinking ● Deductive Reasoning ● Computing ● Applying

Strand E: Data Management and Probability

Competencies for Class XI - Business Mathematics

1. Demonstrate proficiency in determining the central tendencies for diverse data distributions through the application of various strategies.

2. Demonstrate the ability to measure the dispersion of various types of data using an appropriate method.

3. Demonstrate the ability to calculate probabilities for various events by applying the laws of probability and set theory.

Learning Objectives	Content	Process/ Essential Skills
- Understand the meaning of central tendencies and their significance in data analysis. - Know the different types of data distributions: simple distribution, grouped frequency distribution, and ungrouped frequency distribution. - Determine central tendencies (Mean, Median, Mode) of each type of data distributions.	XI B-E1 Measures of Central Tendency Types of data distributions. Define the central tendencies: Mean, Median and Mode, and their applications in real life. Arithmetic Mean for ungrouped and grouped data: Direct Method, Shortcut method and graphical method.	- Defining key concepts - Distinguishing differences - Drawing inferences - Knowledge Application - Problem Solving
- Understand the meaning of dispersion and its significance in data analysis. - Know different methods to measure dispersion: quartile deviation, interquartile deviation, standard deviation, mean deviations and coefficient of quartile deviation. - Compute quartile deviation, interquartile deviation and coefficient of quartile deviation. - Compute standard deviation using various approaches. - Compute mean deviation about mean or median.	XI B-E2 Dispersion Meaning of dispersion and its applications in real-life. Range, interquartile range, semi-interquartile range, quartile deviation, and coefficient of quartile deviation. Mean Deviation. Standard deviation, variance and	- Defining key concepts - Distinguishing differences - Drawing inferences - Knowledge Application - Problem Solving

	coefficient of variance.	
• Know the meaning of basic terms of probability: random experiments, outcomes, sample space, sample point and events. • Know different types of events: simple event, compound event, sure event, impossible event, exhaustive events, mutually exclusive events, not mutually exclusive events, and complementary events. • Solve simple probability problems by drawing sample space diagrams, outcome charts or sets. • Solve probability problems involving 'at least', 'at most', 'exactly', and 'not all'. • Differentiate between dependent and independent events, and calculate probabilities using the addition (OR) rule and multiplication (AND) rule. *(Exclude probability problems involving the selection/arrangement of two or more things, and combining addition and multiplication rule).*	XI B-E3 Probability Random experiment, sample space, and relate to Venn diagrams. Basic terms, and concept of probability. Determining the probability of some random events. Law of addition (OR rule) and solve related probability questions. Dependent and Independent Events: Multiplication law (AND rule) and solve related problems. *(Exclude probabilities involving selection/arrangement of two or more things and simultaneous occurrence of two independent events).*	• Reading Comprehension • Interpretation Information • Information Recall • Knowledge Applying • Analysing • Critical Thinking

Class XI - Mathematics

Strand A: Numbers and Operations

Competencies for Class XI - Mathematics (PMT)

1. Demonstrate the ability to evaluate determinants and apply the concept to determine the areas of triangles and quadrilaterals.

2. Solve real-life problems involving a system of linear equations in two or three variables using determinants and their properties.

3. Exhibit an ability to show the relationship between logarithmic and exponential expressions, and apply the properties and laws of logarithm in solving problems.

4. Demonstrate an understanding of the concept of imaginary and complex numbers and its representation on the argand plane.

5. Display proficiency in applying the properties of complex numbers and their conjugates in carrying out operations on complex numbers.

6. Demonstrate an understanding of the meaning of the symbol $C(n, r)$ and apply the formula in solving related problems.

7. Express an understanding of binomial theorem and its application in expanding expressions with positive indices.

Learning Objectives	Content	Process/ Essential Skills
- Define determinant, and evaluate determinants of orders 2 and 3 by expanding it along any rows or columns. - Determine minors and cofactors for each element of a determinant. - Apply determinants in computing the areas of triangles and quadrilaterals. - Expand determinants efficiently using their relevant properties.	XI P-A1 Determinants Determinant of order two and three. o Minors and co-factors of determinants of order two and three. o Expansion of determinants. o Application of	- Computing - Applying - Analysing - Recognising

• Solve systems of equations in two or three variables using Cramer's rule. • Examine the consistency of a system of equations.	determinants: area of triangles and quadrilaterals. o Properties of determinants. o Solution of simultaneous equations in two and three variables. o Conditions for consistency.	
• Establish connections between exponent laws and logarithmic forms. • Develop a comprehensive understanding of the meaning and concept of logarithms. • Apply theorems and laws of logarithms proficiently to solve logarithmic problems.	XI P-A2 Logarithms Meaning of logarithm. Theorems of logarithms. Laws of logarithms and their properties including the change of base.	• Conceptualising • Computing • Applying • Recognising
• Understand the of concept of imaginary number and its integral powers. • Define the meaning of complex numbers in cartesian form and in ordered-pair form to represent on an argand plane. • Define the meaning and properties of conjugate of a complex number. • Apply the properties of complex numbers and their conjugates to perform	XI P-A3 Complex Numbers Imaginary numbers and Integral powers of i. Definition and properties of complex numbers. Geometrical representation of complex	• Conceptualising • Representing • Applying • Analysing

operations on complex numbers.	numbers in an argand plane. Concept of conjugate of a complex number. Operations: sum, difference, product and quotient of two complex numbers; additive and multiplicative inverse of a complex number.	
• Define the meaning of the symbol of C(n, r) and apply the formula to solve related problems. • Expand binomial expressions with positive indices using binomial theorem. • Evaluate the general, middle term (s), Coefficient of a particular power of x and term independent of x of a binomial expansion.	XI P-A4 Binomial Theorem Factorial notation. Selection and arrangement: C(n, r) and P(n, r). The binomial theorem for positive indices. General and middle terms of binomial expansion.	• Selecting • Arranging • Applying • Analysing

Strand B: Patterns and Algebra

Competencies for Class XI - Mathematics (PMT)

1. Analyse and categorise real-life sequences as either arithmetic or geometric progressions, and address problems by utilising the concepts of nth term and the sum of n terms in a series.

2. Utilise the concept of summation notation to evaluate the sum of a series involving natural numbers.

3. Exhibit the knowledge of implementing remainder and factor theorems in factorization of quadratic and cubic polynomials.

4. Employ the formula methods to solve for the roots of quadratic equations occurring in everyday situations and classify the nature of roots.

5. Display the knowledge of determining and interpreting the roots of quadratic inequalities derived from real world problems.

6. Apply effective methods to resolve different types of rational fractions into partial fractions for its utility in higher mathematical applications.

7. Utilise the concept of functions and their classifications to find solutions to relevant real-life problems and make informed decisions.

8. Demonstrate an understanding of the domain and range of a function by analysing the input and output values of the function.

9. Demonstrate understanding of fundamental theorems on limits to evaluate limits of algebraic and trigonometric functions and examine the continuity of a function.

10. Demonstrate an understanding of the definition of derivative of a function, theoretically and graphically to visualise the slope of a curve at any given point.

11. Employ the knowledge of first principle and basic rules of differentiation to evaluate the equation of tangent and normal to the curve.

12. Demonstrate an understanding of integration as the reverse process of differentiation.

13. Display the ability to apply basic rules of integration to integrate functions derived from real-life applications.

Learning Objectives	Content	Process/ Essential Skills
● Define an arithmetic series and find its nth term. ● Calculate the sum of n terms in an arithmetic series.	XI P-B1 Sequence and series Definition and meaning of	● Analysing ● Applying ● Computing

• Define a geometric progression and determine the nth term of the series. • Calculate the sum of n terms and sum to infinity of a G.P ($|r|<1$). • Differentiate the sequences in real life practices into A.P or G.P and describe their properties. • Illustrate the meaning of summation notation. • Calculate the sum of series involving natural numbers.	sequences and series. Arithmetic progression and Geometric progression; finding the *n*th term (T_n), sum of the series (S_n), and sum of infinity of Geometric progression. Special sums, i.e., $\sum n, \sum n^2, n^3, n \in N;$ Explain the meaning and use of Σ (summation notation). Problems involving the sequences and sum of the series of natural numbers.	
• Apply the remainder and factor theorem in determining remainders and factors of polynomials. • Factorize quadratic and cubic polynomials using the factor theorem.	XI P-B2 Remainder and Factor Theorem Meaning of Rational Integral Function. Remainder Theorem and Factor Theorem. Factorization of quadratic and cubic polynomials.	• Analysing • Applying • Computing

• Factorise quadratic equations and find the roots using different methods. • Determine the nature of roots using the value of discriminant. • Determine the solutions of quadratic inequalities and interpret the roots.	XI P-B3 Quadratic Equations and Functions Solution of quadratic equations by the Formula method. Nature of roots - Real roots, Complex roots, Equal roots. Solving the roots of quadratic inequalities.	• Evaluating • Computing • Analysing • Exploring
• Comprehend the meaning and concept of rational functions in the form $\frac{f(x)}{g(x)}$. • Resolve partial fractions for proper rational fractions. • Resolve partial fractions for rational fractions with denominators containing repeating linear factors. • Resolve partial fractions for rational fractions with denominators containing quadratic factors that cannot be factored into linear terms. • Resolve partial fractions for improper rational fractions.	XI P-B4 Partial Fractions Case I - degree of numerator < degree of denominator o Type 1 - Non repeated linear factors o Type 2 - Repeated linear factor o Type 3 - Quadratic factors (non-resolvable) Case II – degree of numerator $\geq$ degree of denominator	• Applying • Computing

	o Type 1 – Non repeated linear factor o Type 2 – Repeated linear factor	
● Define and differentiate between various types and classifications of functions. ● Determine the inverse of a given function. ● Demonstrate an understanding of undefined functions. ● Perform algebraic operations on functions. ● Determine the domain and range of a given function. ● Mathematize the real life problem into different kinds of functions and interpret the functions to make decisions.	XI P-B5 Functions Concepts of real valued functions and piece functions. Classification of functions. Inverse of a function. Undefined functions. Algebraic operations on functions. Domain and range of a given function.	● Conceptualising ● Computing ● Applying ● Recognising ● Creating
● Understand the fundamental theorems on limits. ● Compute the left-hand limit and right-hand limit to check if the limit at a point exists. ● Use various methods to evaluate the limit of algebraic functions. ● Evaluate the limit of trigonometric functions. ● Check for the continuity of a function both algebraically and graphically.	XI P-B6 Limits and continuity of a functions Meaning of limits. Fundamental theorems on limits. Limits of algebraic and trigonometric functions. Continuity of a function.	● Conceptualising ● Computing ● Applying ● Recognising ● Creating

● Explore the meaning and geometrical interpretation of derivatives. ● Differentiate functions using the first principle. ● Differentiate algebraic functions using basic rules. ● Differentiate trigonometric functions using basic rules. ● Apply the concept of derivatives to find the equations of tangent and normal to the curve.	XI P-B7 Differentiation Meaning and geometrical interpretation of derivatives. Differentiation from first principle. Derivative of simple algebraic, trigonometric, logarithmic functions and their formulae. Derivative of sums, differences, products and quotients of functions. Application of derivatives: Equation of tangent and normal involving algebraic and t-functions.	● Exploring ● Applying ● Computing ● Evaluating
● Understand the meaning of integration, recognizing it as the reverse process of differentiation. ● Evaluate integrals of algebraic and trigonometric functions using basic rules. ● Integrate algebraic and trigonometric functions using the substitution method.	XI P-B8 Integration Indefinite integral: integration as the inverse of differentiation. Anti-derivatives of polynomials and functions like $(ax + b)^n$, $sin\,x$, $cos\,x$, $sec^2 x$, $cosec^2 x$, etc.	● Evaluating ● Applying ● Creating

	Integration by substitution for polynomial and trigonometric functions.	

Strand C: Measurement

Competencies for Class XI - Mathematics (PMT)

1. Demonstrate an ability to apply the concept of compound and multiple angle formulas in solving trigonometric problems.

Learning Objectives	Content	Process/ Essential Skills
• Comprehend addition and subtraction formulas for trigonometric ratios. • Solve problems using the concept of addition and subtraction formulas. • Understand the product formulas and apply them to convert sums and differences to products, as well as products to sums and differences. • Be familiar with double-angle, triple-angle, half-angle, and one-third angle formulas. • Apply double-angle, triple-angle, half-angle, and one-third angle formulas in solving related problems.	XI P-C1 Compound and Multiple Angles Addition and Subtraction formulas; (Double angle, triple angle, half angle and one third angle formula as special cases). Sums and differences as products. Product to sums or differences.	• Conceptualising • Applying • Reasoning • Analysing

Strand D: Geometry

Competencies for Class XI - Mathematics (PMT)

1. Demonstrate a comprehensive understanding of the coordinate system in 2-Dimension, and apply distance, section, and midpoint formulas to delineate a point and a line within a two-dimensional coordinate system.
2. Demonstrate an ability to apply formulas to find the coordinates of centroids and the incenter of a triangle with specified vertices.
3. Interpret the slopes and angles of two lines to articulate the nature of their relationship, whether parallel or perpendicular.
4. Classify and represent an equation of a line in various forms for utility in higher applications of mathematics.
5. Display an ability to visualise and calculate the distance, angle and bisector between two lines occurring on any 2-D plane.
6. Demonstrate proficiency in identifying and representing equations of circles in various forms, adeptly generating circles under specified conditions.
7. Display the ability to analyse geometric configurations involving circles and apply the theorems to deduce unknown angles, arc lengths, and other geometric properties.
8. Demonstrate the ability to engage in logical reasoning and systematically construct rigorous mathematical proofs, allowing them to present a sequence of logical arguments to establish the truth of a given theorem.

Learning Objectives	Content	Process/ Essential Skills
- Apply distance formula to find distance between two points in 2D. - Use the division and midpoint formulas to find the coordinates of points dividing the join of two points. - Determine the coordinates of the centroid and incenter of a triangle with given vertices.	XI P-D1 Points and their Co-ordinates in 2-Dimensions Cartesian system of coordinates. Distance formula and Section formula. Centroid and Incentre of a triangle.	- Conceptualising - Comparing - Reasoning - Applying - Evaluating

● Determine the slopes of a straight line and draw the conditions for parallelism and perpendicularity of two lines ● Use formula to find the angle between two lines.	Conditions of perpendicularity and parallelism of two lines.	
● Express the equation of the straight line in general form, intercept form and normal form. ● Reduce the general equation to the normal form. ● Calculate distance of a point from a line and distance between two parallel lines. ● Calculate angles between two lines using the relevant formula. ● Find the equation of the bisector between the lines. ● Discuss the family of lines and apply it in the relevant context.	XI P-D2 The Straight Lines General equation of a line. Perpendicular/normal form. Distance of a point from a line and distance between parallel lines. Angles between two lines. Equations of lines bisecting the angle between the lines. Identical Lines. Family of lines.	● Conceptualising ● Computing ● Creating ● Applying
● Define a circle and its parts. ● Represent the equation of a circle in standard form, and solve related problems. ● Illustrate theorems of circles using relevant diagrams, and apply the theorems in solving logical problems related to circles.	XI P-D3 Circle and Theorems on Circles. Equations of circles o Centre-radius form o Diameter form Centre and radius from the general equation. Determining equation of a	● Conceptualising ● Representing ● Proving ● Computing ● Applying

	circle for given condition. Theorems of circles.	

Strand E: Data Management and Probability

Competencies for Class XI - Mathematics (PMT)

1. Demonstrate proficiency in determining the central tendencies for diverse data distributions through the application of various strategies.
2. Demonstrate the ability to measure the dispersion of various types of data using an appropriate method.
3. Demonstrate the ability to calculate probabilities for various events by applying the laws of probability and set theory.

Learning Objectives	Content	Process/ Essential Skills
● Understand the meaning of central tendencies and their significance in data analysis. ● Know the different types of data distributions: simple distribution, grouped frequency distribution, and ungrouped frequency distribution. ● Determine central tendencies (Mean, Median, Mode) of each type of data distributions.	XI P-E1 Measures of Central Tendency Mean, Median, Mode; direct Method, formula method and graphical method for grouped and ungrouped data.	● Displaying ● Analysing ● Applying
● Understand the meaning of dispersion and its significance in data analysis. ● Know different methods to measure dispersion: quartile deviation, interquartile deviation, standard deviation, mean deviations, coefficient of quartile deviation.	XI P-E2 Dispersion Meaning of dispersions; Quartile deviation, standard deviation, mean deviation from mean or median.	● Conceptualising ● Applying ● Analysing ● Representing ● Reasoning

● Compute quartile deviation, interquartile deviation and coefficient of quartile deviation. ● Compute standard deviation using various approaches. ● Compute mean deviation about mean or median. ● Calculate mean and standard deviation of combined distributions (two groups only).	Combined mean and standard deviation of two groups.	
● Understand the meaning of basic terms of probability: random experiments, outcomes, sample space, sample point and events. ● Differentiate the different types of events: simple event, compound event, sure event, impossible event, exhaustive events, mutually exclusive events, not mutually exclusive events, and complementary events. ● Solve simple probability problems by drawing sample space diagrams, outcome charts or sets. ● Solve probability problems involving 'at least', 'at most', 'exactly', and 'not all'. ● Differentiate between dependent and independent events, and calculate probabilities using the addition (OR) rule and multiplication (AND) rule. *(Exclude probability problems involving the selection/arrangement of two or*	XI P-E3 Probability Random experiment, sample space, and relate to Venn diagrams. Basic terms, and concept of probability. Determining the probability of some random events. Addition law (OR rule) and solve related probability questions. Dependent and Independent Events: Multiplication law (AND rule) and solve related problems. (Exclude probabilities involving selection/arrangement of two or more things and combining addition and multiplication rule).	● Computing ● Demonstrating ● Applying

more things, and combining addition and multiplication rule).		

Class XII - Business Mathematics

Strand A: Numbers and Operations

Competencies for Class XII - Business Mathematics

1. Show understanding of matrices and apply matrix multiplication to solve practical problems.

2. Demonstrate the ability to solve real-life problems with simultaneous equations in two or three unknowns using the matrix method.

3. Showcase comprehension of annuities by recognizing their future and present values, and adeptly solve associated problems.

4. Demonstrate practical knowledge of annuities in various financial sectors like banking, insurance, and pensions, showcasing their real-world applications.

5. Exhibit comprehension of various types of discounts and apply this knowledge in the context of trade and business transactions.

6. Demonstrate understanding of the bill of exchange and apply its principles in the realms of trade, business, commerce, and economics.

7. Apply skills in using counting principles, P(n, r), and C(n, r) formulas to determine the number of arrangements and selections in various real-life situations.

8. Exhibit the ability to analyse situations and determine the appropriate combinatorial approach.

Learning Objectives	Content	Process/ Essential Skills
● Identify the types of matrices based on the number of elements, their arrangement and order.	XII B-A1 Matrices Types of matrices: rectangular, row,	● Reading Comprehension ● Knowledge Application

● Solve problems involving addition, subtraction and multiplication of matrices. ● Apply matrix multiplications in solving real-life problems. ● Find transpose, adjoint and inverse matrices. ● Solve real-life problems involving systems of equations with two and three variables using matrices. ● Examine the consistency of a given system of equations.	column, square, diagonal, scalar and unit or identity. Operations on matrices: adding, subtracting, and multiplying. Additive inverse of a matrix. (*Omit positive integral powers of matrices*) Application of matrix multiplication in solving simple application questions. Conditions of consistency of the system of linear equations.	● Reasoning ● Conceptualising ● Problem Solving
● Define key terms associated with annuities to establish a foundational understanding of the concepts. ● Differentiate between the present and future value of annuities, and proficiently apply relevant formulas to solve associated problems. ● Apply the understanding of future value of annuities to solve practical problems in real-life situations, including recurring deposits,	XII B-A2 Annuities Meaning of annuities and its related terms. Types of annuities. Classes of annuities. Future and present value of annuity due and	● Conceptualising ● Computing ● Applying ● Analysing

166

insurance schemes, and instalment plans. ● Understand and apply the present value of annuities to solve real-life problems such as computing loan Equated Monthly Instalments (EMI) and determining loan amounts. ● Comprehend and solve problems related to annuity perpetuity, and apply this knowledge in practical scenarios.	ordinary annuity, and their applications in commerce, economics and banking. Perpetual annuity and its applications.	
● Define and understand the terms related to trade discounts. ● Solve practical problems related to trade discounts in buying and selling. ● Define and understand the terms related to the Bill of Exchange. ● Solve problems related to the Bill of Exchange and understand its applications in the trades and business.	XII B-A3 Discount Trade discount, cash discount. True present worth and true discount, Bill of exchange Banker's	● Reading Comprehension ● Making Connections ● Defining key concepts ● Knowledge Application ● Interpreting information ● Conceptualising ● Analysing
● Comprehend the fundamental principle of counting. ● Differentiate between permutations and combinations through illustrative examples. ● Solve permutation problems across various cases. ● Solve combination problems across various cases. ● Solve problems involving both permutations and combinations.	XII B-A4 Permutations and Combinations Fundamental principle of counting. Factorial notations. Permutations and Combination concepts.	● Reading comprehension ● Conceptualising ● Knowledge Application ● Analysing ● Reasoning ● Problem Solving

	Non-circular permutations of *non-repeated,* and *repeated* items.	
	Circular permutations.	
	Combination: Generic types	
	Combination of *n* dissimilar and similar things taken any number of them at a time.	
	Combining permutations and combinations: Generic types, division and distributions of distinct items into groups.	

Strand B: Patterns and Algebra

Competencies for Class XII - Business Mathematics

1. Demonstrate an understanding of the meaning of differentiation and its real-life applications.

2. Showcase skills in differentiating algebraic functions of various forms using appropriate rules.

3. Demonstrate proficiency in employing the knowledge of turning points in determining the maximum and minimum point of a function and apply in business such as cost and revenue.

4. Demonstrate the understanding of integration and determine integrals of algebraic functions using various methods.

5. Exhibit comprehension of total cost, total revenue, demand functions, and adeptly solve associated problems.

6. Show proficiency in applying calculus to optimise costs, revenues, and profits in the realms of commerce and economics.

Learning Objectives	Content	Process/ Essential Skills
- Comprehend the concept of differentiation. - Calculate the first and second derivatives of algebraic functions, including composite, implicit, and parametric functions. - Apply differentiation to algebraic functions with respect to other functions. - Evaluate the derivatives of a function at a specified point and its applications.	XII B-B1 Differentiation Meaning of derivatives. Differentiation of composite, implicit, and parametric functions. Successive differentiation up to 2nd order Differentiation of a function with respect to another function	- Defining key Concepts - Making Connection - Critical thinking - Knowledge Application - Problem Solving
- Understand the different turning points of a function. - Apply higher-order derivatives to check for maximum, minimum, and inflexion points. - Solve simple problems related to maxima and minima.	XII B-B2 Maxima and Minima Maxima and minima and its simple applications. (*Omit problems involving geometric figures*)	- Reading Comprehension - Analysing - Making Connections - Problem Solving

● Understand the concept of integration. ● Evaluate integrals of algebraic functions. ● Apply the substitution method to evaluate integrals. ● Employ the partial fraction method to evaluate integrals of rational fractions.	XII B-B3 Integration The standard method of integration. Integration using substitution and partial fractions.	● Critical Thinking ● Analysing ● Knowledge Application ● Problem Solving
● Define, and write the functions of Total Cost, Variable Cost, Average Cost, Marginal Cost, Total Revenue, Marginal Revenue and Average Revenue. ● Find the break-even points, average cost and average revenue. ● Find the marginal cost and marginal revenue by applying the idea of differentiation. ● Determine the functions that maximise profits and revenues, and minimise costs, using the concept of maxima and minima. ● Determine total cost and total revenue function using the concept of integration.	XII B-B4 Application of Calculus in Commerce and Economics Functions related to business and economics: Cost, demand, revenue, profit, break-even point, average and marginal cost, average and marginal revenue. Finding cost and revenue function from the marginal cost and marginal revenue function using integration.	● Reading Comprehension ● Information Recall ● Interpreting Information ● Knowledge Application ● Problem Solving

Strand C and D: Measurement and Geometry

Competencies for Class XII - Business Mathematics

1. Demonstrate an understanding of the meaning of conic sections and the ability to identify their constituent parts.

2. Exhibit the capacity to apply the concepts of conic sections in solving problems related to real-life situations.

3. Demonstrate comprehension of the distance, section and midpoint formula by applying them in relevant scenarios.

4. Display an understanding of the relationship between direction cosines and direction ratios to illustrate conditions of parallelism and perpendicularity between two lines in real-world situations.

Learning Objectives	Content	Process/ Essential Skills
- Identify various types of conic sections through analysis of graphs and equations. - Determine the components of conic sections centred at the origin, including focus, directrix, vertex, axes, centre, latus rectum, and eccentricity. - Formulate the equation of conic sections centred at the origin in standard form. - Apply the principles of conic sections to solve problems related real-life scenarios.	XII B-CD1 The Conic Section Definition of conic sections. Types of conic sections and their eccentricity. Parabola and its parts. Ellipse and its parts. Hyperbola and its parts. Application of conic sections in real life.	- Conceptualising - Representing - Analysing - Connecting - Applying
Comprehend the 3-D coordinate system and articulate the	XII B-CD2	Information Recall

positioning of a point in 3-D space. • Solve problems related to distance formula, section formulae, and midpoint formula. • Calculate direction ratios and direction cosines of a line in 3-D space. • Determine the angle between two lines using direction cosines and direction ratios. • Assess the parallelism and perpendicularity of two lines in 3-D space.	Points and Their Coordinates in 3-Dimensions A coordinate system and coordinates of a point in 3-D space. Distance formula, section formula and midpoint formula. Direction cosines and Direction ratios. Angle between two lines. Conditions for perpendicularity and parallelism (*Omit problems involving geometric figures*).	• Critical Thinking • Analysing • Knowledge Application • Problem Solving

Strand E: Data Management and Probability

Competencies for Class XII - Business Mathematics

1. Demonstrate understanding of the correlation coefficients, analyse and describe a data set by finding an appropriate correlation coefficient.

2. Demonstrate an ability to analyse relationships between variables, make informed predictions and decisions based on statistical patterns in data.

3. Demonstrate the skills to solve real-life probability problems by applying the concepts of independent and dependent events, conditional probabilities, and

permutations and combinations.

Learning Objectives	Content	Process/ Essential Skills
- Understand the significance of Correlation Coefficients in different fields. - Calculate and interpret Karl Pearson's coefficient of correlation for ungrouped data collected from real life experiments. - Calculate and interpret Spearman's Rank correlation coefficient for ungrouped data.	XII B-E1 Correlation Coefficient of correlation by Karl Pearson's method for ungrouped data. Rank correlation coefficient by Spearman's method.	- Information Recall - Drawing inferences - Knowledge Application - Problem Solving
- Interpret the meaning of regression coefficients and understand the significance of the regression line. - Determine regression coefficients and equations. - Utilise regression lines to interpret data distribution means and standard deviations. - Apply this knowledge to generate regression lines of real-life data, facilitating accurate estimations.	XII B-E2 Regression Definition of regression. Method of curve fitting (Least squares). Lines of regression. Properties of regression lines.	- Drawing inferences - Defining key concepts - Knowledge Application - Problem Solving
- Use the concept of permutation and combination in calculating probability. - Determine probability by applying laws (addition (OR) rule, multiplication (AND) rule) for the problems containing selection/arrangement of two or more things. - Solve probability problems by using both the addition and multiplication theorems of probability.	XII B-E3 Calculating Probability Different Types of Events. Probability using permutations and Combinations. Application of laws of	- Identifying - Applying - Analysing - Problem Solving - Interpreting Information

Determine the conditional probability of two dependent events.	probability in simultaneous occurrence of two independent events. Conditional Probability.	

Class XII - Mathematics

Strand A: Numbers and Operations

Competencies for Class XII - Mathematics (PMT)

1. Demonstrate understanding of matrices and apply matrix multiplication in real-life problems.

2. Exhibit an ability to solve real-life problems involving simultaneous equations in two or three unknown variables by matrix method.

3. Employ the knowledge of modulus and argument of complex numbers to describe the cartesian and polar form of complex numbers.

4. Express the understanding of complex numbers in describing various loci and calculating square roots of complex numbers and cube roots of unity.

5. Apply skills in using counting principles, P(n, r), and C(n, r) formulas to determine the number of arrangements and selections in various real-life situations.

6. Exhibit the ability to analyse situations and determine the appropriate combinatorial approach.

Learning Objectives	Content	Process/ Essential Skills
● Identity and describe the dimensions of matrices and perform operations on matrices.	XII P-A1 Matrices Dimensions of matrices and	● Conceptualising ● Applying ● Reasoning

• Apply matrix multiplications in solving real-life problems. • Evaluate the transpose, adjoint and inverse of a matrix. • Solve real-life problems involving systems of equations with two and three variables using matrices. • Examine the consistency of a given system of equations.	operations on matrices. Application of matrix multiplications. Transpose, adjoint and inverse of matrices. Use matrices to solve simultaneous linear equations in two and three unknowns. Conditions of consistency of system of linear equations.	• Describing
• Find the modulus and argument of a complex number. • Represent the cartesian form of complex numbers in polar form and vice versa. • Solve locus problems related to complex numbers. • Calculate square root of complex number. • Investigate cube roots of unity and its properties.	XII P-A2 Complex Numbers Modulus of complex numbers and properties. Argument or amplitude of a complex number. Polar form of complex number. Locus problems. Square roots of complex numbers. Cube roots of unity and its properties.	• Computing • Applying • Analysing • Illustrating

• Comprehend the fundamental principle of counting. • Differentiate between permutations and combinations through illustrative examples. • Solve permutation and combination problems across various cases. • Solve problems involving both permutations and combinations.	XII P-A3 Permutations and Combinations Concept of Permutation P(n, r). Restricted permutation; Permutation of alike things; Circular permutations. Concept of Combination C(n, r). Restricted combinations; Distribution of different things into groups; Open selection of items from different things and from alike things. Mixed problems on permutation and combination.	• Conceptualising • Computing • Applying • Selecting • Arranging • Analysing

Strand B: Patterns and Algebra

Competencies for Class XII - Mathematics (PMT)

1. Demonstrate proficiency in employing appropriate methods of differentiation to calculate both first and higher-order derivatives across various functions.

2. Apply the understanding of turning points to effectively address optimization challenges in practical, geometrical, and mensuration problems within real-world scenarios.

3. Indicate understanding of applying relevant methods to evaluate the indefinite integrals of various types of functions.

4. Employ the methods of limit of sum and by use of properties to evaluate definite integrals.

5. Show an ability to utilise integration for finding the area under curves and volumes of irregular shapes, quantifying spatial relationships within real-world scenarios.

6. Demonstrate an understanding of differential equations in various forms to effectively employ suitable methods for solving each type of differential equation.

Learning Objectives	Content	Process/ Essential Skills
• Evaluate first derivatives of algebraic, trigonometric, inverse trigonometric (including 'by transformation'), logarithmic and exponential functions in simple, composite, absolute and implicit forms. • Understand the method of differentiation of parametric functions, differentiation of a function with respect to another function and logarithmic differentiation. • Evaluate higher order derivatives (successive differentiation) of all the types of functions. • Determine and interpret the turning points of a function using higher derivatives. • Apply the concept of maxima and minima in solving and optimising practical,	XII P-B1 Differentiation Derivatives of trigonometric, logarithmic, and exponential functions in simple and composite forms. Derivatives of inverse trigonometric functions reducible to simple form by substitution. Derivatives of implicit functions. Derivatives of Parametric functions. Differentiation of function with respect to another function. Logarithmic differentiation.	• Conceptualising • Computing • Applying • Analysing • Evaluating

geometrical and mensuration problems in real life.	Successive differentiation or higher order derivatives. Turning points - Maxima, Minima and Point of inflection. Applications of maxima and minima to practical, geometrical and mensuration problems.	
• Evaluate integrals of different types of functions using relevant methods: by substitution, by parts and using partial fractions. • Evaluate definite integrals using basic rules, by substitution, as limit of sums and by using properties. • Employ the concept of definite integral in calculation of area under a curve and area between two curves. • Apply the concept of definite integrals to find the volume of revolution about the x-axis or y-axis or about a line. • Find the area and volume of regular and irregular shapes in our surroundings using definite integrals.	XII P-B2 Integration Standard method of integration of the type: $\frac{1}{x}, e^x, \tan \tan x, \cot \cot x,$ $cosec\, x,$ and $(ax + b)^n$ Integration by using substitution. Integration by parts. Integration using partial fractions. Definite integral as a limit of sum. Properties of definite Integrals (without proof). Application of definite integrals – area of a curve included between x or y axis and between two curves;	• Conceptualising • Evaluating • Computing • Analysing • Exploring

	volume of revolution about the x-axis or y-axis or about a line.	
• Identify the order, degree and linearity of Differential Equation (DE). • Evaluate the general and particular solutions for variable separable, homogeneous, linear and second order linear differential equations.	XII P-B3 Differential Equations Meaning of differential equation; order and degree of a differential equation. Solution of differential equation of 1st order and 1st degree. Variable separable. Homogenous equations and equations reducible to homogeneous form. Linear equations of the form; where P and Q are functions of x only. Solution of differential equations of second order.	• Conceptualising • Applying • Computing • Analysing

Strand C: Measurement

Competencies for Class XII - Mathematics (PMT)

1. Exhibit the meaning and principal values of inverse trigonometric functions and apply the properties to solve related problems.

Learning Objectives	Content	Process/ Essential Skills

Learning Objectives	Content	Process/ Essential Skills
• Discuss the definition and principal values of inverse trigonometric functions. • Apply properties of inverse trigonometric functions to solve problems.	XII P-C1 Inverse Trigonometric Functions Meaning of inverse trigonometric functions. Principal values. Properties of inverse trigonometric functions.	• Conceptualising • Applying • Reasoning • Analyzing

Strand D: Geometry

Competencies for Class XII - Mathematics (PMT)

1. Demonstrate the understanding of the distance, section, and midpoint formula by applying in relevant scenarios.
2. Display an understanding of the relationship between direction cosines and direction ratios to illustrate conditions of parallelism and perpendicularity between two lines in real-world situations.
3. Demonstrate an understanding of concepts related to a pair of straight lines and use of graphing tools to represent each theorem of pairs of straight lines.
4. Apply the conditions to show that the given general equation represents a pair of straight lines.
5. Utilise the general equation of a pair of straight lines to determine angles between two lines, point of intersection, equation of the bisector between lines and individual equations in the pair.
6. Show an understanding of conic sections and their geometric components by utilising interactive tools for deriving the equation of each conic section.
7. Demonstrate the ability to apply the concepts of conic sections effectively in solving real-life problems.
8. Visualise and demonstrate an understanding of equations of planes in various forms and generate the equations of planes for given conditions.
9. Apply the formula to calculate the distance and angle between two planes and illustrate using examples in real world space.

Learning Objectives	Content	Process/ Essential Skills

• Comprehend the 3-D coordinate system and articulate the positioning of a point in 3-D space. • Solve problems related to distance, section, and midpoint formula. • Calculate direction ratios and direction cosines of a line in 3-D space. • Determine the angle between two lines using direction cosines and direction ratios. • Assess the parallelism and perpendicularity of two lines in 3-D space.	XII P-D1 Points and Their Co-ordinates in 3-Dimensions Introduce points and their coordinates in 3D space. Distance between two points; section and midpoint formulas. Direction cosines and direction ratios of a line. Angle between two lines. Conditions of lines to be parallel or perpendicular.	• Conceptualising • Applying • Analysing • Illustrating
• Demonstrate using graphing tools, the concepts and theorems related to pairs of straight lines using relevant examples. • Employ the conditions to show that the given general equation represents a pair of straight lines. • Use the general equation of a pair of lines to determine point of intersection, angles between two lines and equation of the bisector between the lines. • Resolve the general equation of a pair of straight lines into two individual equations of straight lines.	XII P-D2 Pairs of Straight Lines General equation of second degree in x and y representing a pair of lines. Conditions for general second-degree equations to represent a pair of straight lines. Reduction of general	• Applying • Analysing • Evaluating • Illustrating

● Find the distance between the two parallel lines	equation to individual equation. Point of intersection and angle between the pair of lines in homogeneous and general equations. Equation of the bisector of the angle between a pair of given straight lines. Distance between two parallel lines.	
● Define and comprehend the three types of conic sections based on eccentricity. ● Define and determine the elements of a parabola, including the vertex, focus, directrix, axis, latus rectum, and eccentricity, along with its equations in both standard and general forms. ● Explore the components of ellipses and hyperbolas, encompassing the centre, vertices, foci, directrices, axes, latus recta, and eccentricity, along with their equations in standard and general forms. ● Examine the conditions necessary for classifying general conics. ● Establish connections between the concepts of conics and their	XII P-D3 The Conic Section Conics as sections of a plane and a right circular cone. Definition of conic sections. Equation of a parabola, ellipse and hyperbola in standard form and general form. Finding the equation for a conic when focus, directrix, and	● Conceptualising ● Representing ● Computing ● Connecting ● Applying

applications in solving real-life problems.	eccentricity are given. Finding basic information from a given equation of conic. Conditions to classify the general conics.	
• Use visual representations (interactive tools) to understand the concept of planes in each form: one-point form, normal form and intercept form • Calculate distance and angle between two planes with relevant examples in real world space • Generate the equation of the planes when different conditions are given.	XII P-D4 Plane Meaning of plane. Different forms of equation of plane: one point form, normal form and intercept form. Distance of a point from a plane and distance between two planes. Angle between two planes. Equation of planes under different conditions.	• Conceptualising • Analysing • Representing • Reasoning

Strand E: Data Management and Probability

Competencies for Class XII - Mathematics (PMT)

1. Determine and interpret the coefficient of correlation between two variables in data collected in real world context to study the correlation between them.

2. Demonstrate an ability to analyse relationships between variables, make informed predictions and decisions based on statistical patterns in data.

3. Utilise the concepts of permutations and combinations in determining probabilities of various events related to real-life situations.

4. Solve probability problems involving the use of both addition and multiplication theorems.

5. Utilise different methods to compute the conditional probability of two dependent events.

Learning Objectives	Content	Process/ Essential Skills
● Understand the significance of Correlation Coefficients in different fields. ● Calculate and interpret Karl Pearson's coefficient of correlation for ungrouped data collected from real life experiments. ● Calculate and interpret Spearman's Rank correlation coefficient for ungrouped data.	XII P-E1 Correlation Definition and meaning of correlations coefficient. Calculation of coefficient of correlation by Karl Pearson's method for ungrouped data. Rank correlation coefficient by Spearman's method.	● Decision making ● Analysing ● Interpreting ● Evaluating
● Interpret the meaning of regression coefficients and understand the significance of the regression line. ● Determine regression coefficients and equations. ● Utilise means and standard deviations to find lines of regression. ● Apply this knowledge to generate regression lines for real-life data, facilitating accurate estimations.	XII P-E2 Regression Definition of regression. Coefficient and the two lines of regression. Use of regression lines to interpret means, standard deviations and make predictions.	● Decision making ● Analysing ● Interpreting ● Evaluating

	Generate lines of regression from given data.	
• Use the concept of permutation and combination in calculating probability. • Solve probability problems by using both the addition and multiplication theorems of probability. • Determine probability by applying laws (addition (OR) rule, multiplication (AND) rule) for the problems containing selection/arrangement of two or more things. • Determine the conditional probability of two dependent events.	XII P-E3 Probability Probability using Permutations and Combinations. Application of combined theorems of probability (addition and multiplication). Conditional Probability.	• Identifying • Applying • Analysing • Problem Solving • Interpreting Information

8. Teaching and Learning Approaches

The process of teaching and learning is the critical phase in the process of curriculum development and its delivery. Effective delivery of curriculum is crucial to achieve the aspired competencies by students as they complete school education.

Effective teaching approaches should equip students for life as well as support life-long learning; build interdisciplinary and cross-curricular skills, concepts, knowledge, and values; facilitate integration of knowledge, skills, and values within and across the disciplines; promote enduring understanding and deeper learning; and promote collaboration, cooperation, and shared learning, thus promoting active engagement of the students in the learning process.

The following process shall be at the heart of mathematics teaching to facilitate aspired student learning.

6.1 Establishing a safe and positive learning environment

A class that students feel safe to come to and to learn and that allows students to grapple with mathematical problems related to real life helps to promote social emotional wellbeing and learning. They are critical life skills which facilitate students to navigate through adversities.

A positive learning environment in mathematics:
- establishes interaction and rapport between the student and teacher and among students themselves,
- encourages students to recognize that mathematics is vital for life,
- allows students to raise issues and problems they face in real life, and facilitates in finding mathematical solution to the problem, Students are able to showcase mathematical connection with everyday life everywhere.

6.2 Designing lessons that focus on knowledge construction and transfer

The focus of mathematics lessons should be on guiding students to:
- construct desired mathematical knowledge using concrete, pictorial/representation and abstract approach that facilitates deeper learning of mathematical concepts,

- transfer (apply) the constructed mathematical knowledge in familiar as well as new situations through experiential learning, problem based learning and project based learning.

6.3 Making provisions for making mathematical connections, representations and communication

Connecting mathematics within and across topics helps students to appreciate the interconnectedness of different mathematical ideas and the relationships that exist between mathematics and real life. When students have opportunities to apply mathematics in everyday contexts, they learn about its value to society and its contribution to other areas of knowledge.

Representation is the way of concretising or visualising mathematics with physical material and tools or by using ICT tools. When students see concrete or visual representations of mathematical ideas, their learning becomes deeper.

Making students to communicate mathematics by encouraging students to pose questions, justify claims, and write or critique mathematical explanations and arguments. In this way students will be engaged in reasoning and critical thinking. When students engage in examining conjectures, disagreements, and counter-arguments, they learn how to use mathematical ideas, language, and methods in making meaning of the data and the world around.

6.4 Encouraging divergent thinking

Stimulate students to pose questions or create appropriate situations. For example, asking, "4+4= 10?" instead of asking, "what is 5 + 5?" opens up multiple possibilities that encourages students to realise that there are multiple ways of arriving at solutions to problems.

6.5 Using a variety of instructional strategies

Strategies such as:

- differentiated instruction to include all types of students to learn at their own pace while also supporting the collaborative learning
- design thinking

- inquiry based learning, etc.

6.6 Encouraging reflective practices

Encourage students to practise reflection at critical phases of lessons to enable students to think about where they are in their learning, and what they need to do to reach where they need to.

6.7 Embedding assessment and feedback into the lesson

Embed assessment through meaningful assignments to assess learning of content, processes or desired competencies.

6.8 Teaching and learning approaches recommended in the NSCF

The set of teaching and learning strategies stipulated in the NSCF are integrated in the teaching and learning of mathematics as and where relevant:

- Competency based education learning approaches
- Place based education approaches
- Pedagogies for developing and advancing 21st century skills
- Blended learning approaches to use both face-to-face teaching as well as electronic and online media

The use of Information and Communication Technology for Teaching and Learning

ICT is an important tool for addressing varied learning styles of students. ICT tools can help students to understand mathematical concepts through visualisations, simulations and representations. Learning platforms can help to design personalised learning for every student where he/she can progress at his/her own pace and also assess his/her own learning. ICT tools can also support students to communicate ideas and collaborate with one another as part of the knowledge building process.

Teachers need to use ICT to provide a better learning experience to the students

than without using ICT, and for assessing student learning and providing immediate feedback. However, it is critical for teachers to decide when and how to use ICT.

Doing mathematics using paper and physical mathematical tools as well as using ICT tools has its own benefits. Doing constructions is always better than watching a video on how construction is done. Drawing and measuring 5 cm on a paper is better than constructing 5 cm on a computer screen as the actual 5 cm length on the screen may vary due to screen resolution or screen size. While, on the other hand, using ICT would help to save time to represent and calculate the 5-number summary of a large volume of data so that more time can be devoted to focus on how the data is behaving and draw conclusions and recommend solutions.

9. Assessing Mathematics Learning

Assessment is an integral part of teaching and learning. It should be embedded into the instruction, should be an on-going, dynamic and both informal and formal process. Assessment is particularly helpful in mathematics because of the highly structured nature of the subject. It should form a cyclical process of gathering evidence about a student's knowledge, his/her ability to apply the knowledge, and making inferences from the evidence to provide:

- students with frequent and meaningful feedback on their learning;
- teachers with information that can be used to answer the needs of the students, realistically;
- parents with information about their children's performance in the context of what they are studying;
- administrator's feedback on student achievement and difficulties.

Mathematics learning is based on three processes – formulating situations mathematically, applying concepts, facts and procedures and interpreting the result obtained with respect to the problem, six broad competencies that cut across all the stands– communicating, mathematizing, representation, reasoning and argument, devising strategies to problem solving and using mathematical language, tools and technology support the development of mathematical competencies and the means of assessment.

All formative assessments as well as summative assessments should focus on measuring the degree of learning based on the three processes and the competencies through appropriate student-generated or teacher-recommended performance tasks. It should emphasize on finding out what pupils know, what they can do, and how they do it, rather than focusing on what they cannot do. It should consider both the processes and the product of learning while a student engages in:

- constructing desired mathematical knowledge;
- transferring (applying) the constructed mathematical knowledge in familiar as well as new situations.

Recognizing that students learn in different ways and also demonstrate their learning in different ways, teachers use a variety of ways to demonstrate what they know and can do. For example, young children can show what they know and can do either by doing or by telling. Therefore, a teacher must use assessment strategies of observing what a child is doing, or listening to what a child is telling and asking probing questions with appropriate tools, such as checklist, rating scale, or rubric to assess their learning.

Domains of Assessment

Assessment in mathematics is based on three domains of learning – the Mathematical Knowledge (MK), Mathematical Process (MP) and Mathematical Competency (MC) across all the chapters, topics and activities. Assessment of mathematical competency ensures gauging what drives a student to use what the student knows and how to solve problems. These three domains of learning are assessed both in formative and summative. The three domains of learning in mathematics are reflected below.

i.   Mathematical Knowledge (MK)

This domain focuses on core concepts. A student should demonstrate knowledge and understanding in relation to learning objectives under each topic focusing on reproduction, definition and computation.

ii.   Mathematical Process (MP)

This domain focuses on mathematical processes. A student should demonstrate development in processes of formulating situations mathematically, applying concepts, facts and procedure, and interpreting mathematical results based on the learning objectives under each topic under each strand.

iii.   Mathematical Competency (MC)

This domain focuses on mathematical competency that comprises knowledge, processes and students' disposition in using the knowledge. It encompasses how a student exhibits competence in communication, mathematizing, representation, reasoning and argument, devising strategies to solve problems and using mathematical language, tools and technology. In this manner it enables to gauge students' interest, curiosity, intellectual drive, creativity, exploring and inquiring zeal and skills, facts finding, coherent presentation of ideas, reasoning skills, collaboration, respect and concern for all, etc.

Types of Assessment

All assessments are formative for key stage one. For key stage 2-5, it comprises formative and summative assessment modes. Whatever tools and techniques of assessment are used, the evidence from the assessment are categorised into five levels of achievement as follows:

i.   **Exceeding** (80 -100): The learner has extensive knowledge and understanding of the context and can readily apply this knowledge at any given time. In addition, the learner has achieved a very high level of competency in the processes and skills and can apply in new situations. The learner has achieved a high level of critical thinking, creativity, and is able to communicate and collaborate effectively in all situations.

ii.   **Advancing** (60-79): The learner has thorough knowledge and understanding of the content and relatively high level of competency in the processes and skills. In addition, the learner is able to apply this knowledge and skills in most

situations. The learner displays critical thinking, creativity, and communicates and collaborates appropriately in almost all situations.

iii. **Meeting** (40-59): The learner possesses foundational and functional knowledge and understanding of the main areas of academic content with an adequate level of competency in the processes and skills. The learner possesses a certain degree of critical thinking, creativity, and is able to communicate and collaborate in most of the situations.

iv. **Approaching** (20-39): The learner possesses basic knowledge and understanding of the academic content, and has achieved limited level of competency in the processes and skills. The learner is able to collaborate with close friends and has limited communication skills.

v. **Beginning** (0-19): The learner possesses limited basic knowledge and understanding in few areas of the content; has achieved very limited competency in most of the processes and skills. The learner possesses limited communication and collaboration skills.

The evidence from the data should be used to support students in the beginning and approaching levels by differentiating instruction till they reach the meeting level.

Summative assessment in the form of unit tests, mid terminal examinations and annual examinations shall be carried out. However, data from these examinations will be used formatively to gather evidence to adjust instruction accordingly.

Recording Student Learning

For all key stages, formative assessment information is recorded based on the achievement based on the prescribed learning competency for each strand in five levels in the following manner during the teaching learning process.

Strand:			Content/Topic:		
Competency:					
	Level of Achievement				
Name	Beginning	Approaching	Meeting	Advancing	Exceeding

Marks obtained for each strand and ultimately for each subject from the formative assessment can be converted using appropriate conversions for summative purpose.

Assign scores to each level of achievement (1 for beginning, 2 for approaching, 3 for meeting, 4 for advancing, and 5 for exceeding)

$$\text{CA marks} = \frac{Sum\ of\ score\ obtained\ for\ all\ competencies}{Total\ scores\ for\ all\ competencies} \times \text{CA for the term}$$

The format for recording shall also be based on the policy decisions made from time to time. As of now, for key stage I, the recording is based on the levels of achievement for each strand, and for other key stages (2-5) it is based on the marks as per the progress report format.

Reporting Student Learning

Reporting student learning to all stakeholders will be subject to policy changes that are made from time to time. The format for reporting shall also be based on the policy decisions made from time to time. As of now, for key stage one, the reporting is based on the levels of achievement, and for other key stages (2-5) it is based on the marks as per the existing progress report format.

Summary Table for Assessing Mathematics Learning			
Domains	Mathematical Knowledge (MK)	Mathematical Process (MP)	Mathematical Competency (MC)
Forms of Assessment	Formative Assessment	Formative Assessment Summative Assessment	Formative Assessment Summative Assessment
Purpose of Assessment	To gauge student knowledge through: - Reproduction - Definition - Computation	To gauge student learning in the process of: - Formulating situations mathematically - Applying concepts, facts and procedures - Interpreting mathematical result	To gauge student capacity in: - Communicating - Mathematizing - Representation - Reasoning and argument - Devising strategies to solve problems and - Using mathematical language, tools and technology.
Assessment Techniques	Observing, listening etc. during immediate interaction with students when students are engaged in class work, performance tasks or real-life contextual problems.		- Observing, listening etc. during immediate interaction with students when students are engaged in class work, performance tasks or real-life contextual problems. - Tests and terminal examinations.
Assessment Tools	Checklists, questions and answers, rubrics, journals, anecdotal records, tests, quizzes, digital tools etc.		
Frequency	Throughout the academic session	Formative: Throughout the academic session Summative: Every after chapter/unit	Formative: Throughout the academic session Summative: Every after chapter/unit
Recording and Reporting	- All recording for formative assessment shall be done as per the five levels of achievement and converted to scores as required for each key stage. - All reporting shall be based on format decided from time to time through policy decisions for each key stage		

10. Enabling Conditions

Appropriate, adequate conditions are prerequisites to effectively deliver curriculum in general and mathematics curriculum in particular. A conducive school environment to ensure that the intentions of the curriculum are achieved. Therefore, the following enabling conditions are mandatory for the effective implementation of the mathematics curriculum:

8.1 Human Resource

For creating conducive teaching and learning environment for the effective implementation of the Mathematics curriculum, the following facilities are imperative:

- **Trained mathematics teachers**

Teachers are an important component of any education system. Trained mathematics teachers are important in translating the curriculum intentions into classroom context in the mathematics education. It is critical that mathematics is taught by specialised/trained mathematics teachers at all class levels. Teachers must be enough and must be adequately trained with provision for continued in-service professional support.

- **School leadership support**

The role of school leadership is critical in ensuring adequate trained teachers are recruited, and allocate flexi time for adopting progressive teaching approaches to enhance student learning of mathematics. School leadership ensures the formation of teacher professional learning communities and regular meetings are convened based on needs.

8.2 Physical Resources

Curriculum implementation depends largely on resources available in schools. Lack of resources necessary for the execution of teaching and learning can inhibit effective curriculum implementation. Providing essential materials allows teachers to focus their attention on teaching their students, rather than tracking down materials they do not have.

In order to effectively implement curriculum and create conducive teaching and learning environment, the schools should be equipped with:
- Adequate mathematical manipulatives like counters, snap cubes, pattern block, 3-D shapes, fraction strips, grid, geo-board, etc.

- Technology support: Hardware like computers and laptops should be made available and software (like teaching and learning resources, providing links for important mathematical resources, using dynamic software (like Geogebra) for teaching mathematics concepts) should be made available.
- Each school should establish a mathematics laboratory to provide space for innovation and exploration of mathematical concepts and appropriate knowledge creation.

8.3 Role of Parents

Parents play a vital role in the effective implementation of any curriculum and mathematics education is no different. They should have parental guidance and support in learning and development, and collaborate with school to monitor the progress of their children. Parents should also provide a conducive home environment that supports the learning of their children which will help them to develop creativity, sharpen their focus and increase their motivation for learning.

8.4 Roles and Responsibilities of Service Providers

The successful implementation of mathematics curriculum requires clear roles and support by different relevant stakeholders to enable schools to meet curriculum intentions.

i. Ministry of Education (MoE)

- Ensures adequate human resources, infrastructure development, adequate curriculum support materials and budgetary support to enable effective curriculum implementation of the mathematics curriculum.
- Establishes protocols to provide timely monitoring to ensure adequate human resources, infrastructure development, adequate curriculum support materials and budgetary support to enable effective curriculum implementation.

ii. Department of Curriculum and Professional Development (DCPD)

- Review, innovate, design and develop the national curriculum and professional development programmes based on feedback from the field.
- Disseminate the curricular changes and ensure the changes are implemented in the schools.
- Provide timely professional development for efficient implementation of the curriculum.
- Conduct periodic monitoring for professional support services.

Bhutan Council for School Examination and Assessment (BCSEA)

- Conducts national assessment to monitor student performances.
- Conducts board examinations based on the mathematics curriculum.
- Provides professional development in assessment.
- Disseminates result analysis reports to various stakeholders.

iv. Dzongkhag and Thromde

- Disseminate information and ensure the changes are implemented in the schools based on national directives.
- Facilitate the placement of human resources and supply of material resources.
- Facilitates the organisation of professional development programmes based on the needs of the school leaders, teachers and other staff within the dzongkhag and thromde.
- Monitors school level curriculum implementation and reports to relevant agencies.
- Provides regular feedback on the effectiveness of curriculum to relevant agencies.

v. Schools

- Implement mathematics curriculum as per the mathematics curriculum framework and other curricular policies related to mathematics education that are issued from time to time.
- Create a conducive and teaching-learning environment.
- Ensure teachers and students receive adequate teaching and learning materials.
- Provide timely professional development programmes to the teachers, students and other staff.
- Provide feedback on the curriculum to DCPD.
- Provide timely reports on students' performances to relevant agencies and stakeholders.

8.5 Effective Monitoring and Support Services

A sound protocol for carrying out monitoring and support services effectively must be put in place in order to bridge the gap between the intended and implemented curriculum.

Monitoring and support at the National and Dzongkhag levels is to:

- Check whether schools adhere to the policies related to the implementation of curriculum,

- Identify shortcomings and gaps in the curricular policies and take necessary measures to address these gaps,
- Conduct needs assessment (both professional and resources) at the school level and make necessary arrangements to address these needs, and
- Provide timely feedback and report to the relevant agencies to improve service delivery, coordination, and fix accountability if necessary

11. Cross Curricular Linkages

All learning areas can provide various contexts to learn or use mathematics at a lesser or larger level. Mathematics enables us to concretise concepts and facts in different learning areas. By purposefully drawing connections across all areas of mathematics and to other subject areas, and by applying learning to relevant real-life contexts, students can extend and enhance their learning experiences in deepening their knowledge and skills across disciplines and beyond the classroom.

Some examples of cross curricular linkages in some disciplines are as follows:

Mathematics and English

Mathematics lessons help to develop literacy skills by teaching mathematical vocabulary and technical terms. Students enrich their English proficiency by engaging students in reading and interpreting problems to identify the mathematics operation to solve problems. It also requires students to explain their methods and strategies to others and present their findings and conclusions. English lessons may provide non-fiction texts in which mathematical information in the form of graphs, tables or charts may need to be interpreted and explained.

- Provide written explanations for solutions to maths problems.
- Create a chart or graph to show the choice of books students in your class level prefers to read.
- Read stories that include counting, maths facts, etc.
- Create a maths journal. Provide topics to write on like: write an explanation of a recently-learned concept, as if you were explaining it to a younger sibling or friend, write as many examples of a ratio that you can think of in five minutes or write a paragraph explaining a selected graph.

Mathematics and Science

A large part of the science curriculum requires the application of mathematical skills. Every part of scientific enquiry requires some mathematical skills. This involves classifying, counting, measuring, calculating, estimating and recording in charts, tables or graphs. It also involves the use of mathematical equations and formulae, where the students have to use and manipulate various formulae. Science provides the students with many opportunities to apply mathematical skills in real life contexts. Some examples are:

- Write the distance between the sun and each planet using exponential form.
- Explore the half-life of certain radioactive elements or the size of bacteria and viruses using negative exponents.

- Explore scientific facts, such as the boiling and freezing point of liquids, the melting and freezing point of solids and the temperature of planets.
- Use algebra to calculate how much force a given magnet would require to pull another magnet.
- Use maths to prove various laws of physics.
- Measure and collect scientific data and use graphs, charts, lists, tables etc. to organize the collected data.

Mathematics and Art

The Art Education learning relies quite heavily on the student being able to measure and use spatial skills and the properties of shapes including the use of symmetry and tessellations. Artistic designs may require enlarging or reducing and the use of ratios and proportions may be required. Both metric and imperial measurements and conversions may be taught and used. Some examples are:

- Create a geometric greeting card using shapes that are congruent, similar, and equivalent.
- Examine works of art that incorporate geometric shapes.
- Create tessellations.
- Play with tangrams.
- Create a piece of artwork using perspective and proportion.

Mathematics and ICT (Coding and Computing)

Students are able to use skills of collecting, classifying and representing data by using data handling software and produce graphs and tables and interpret their results. They may use computer models and simulations that will require their ability to manipulate numbers and identify patterns and relationships. When using programming software, they require arithmetic skill and algebraic understanding to structure, store and manipulate data successfully in their applications. Computational thinking is central to the algorithm and programming element of the ICT curriculum which has a strong emphasis on problem solving and logic. Arithmetic skills are used to convert to and be able to manipulate different number systems (binary and decimal systems). In addition, coding may require the manipulation of numbers and a knowledge of mathematical methods to enable them to function.

Mathematics and the Social Sciences

In History and Geography students may collect data by measuring or counting and recording results in the form of charts, tables or graphs. They will also need to interpret data presented in the form of charts or graphs. Historical ideas require an understanding of time and time lines similar to the number line. Map skills require the understanding of coordinates and ideas of angles, directions, position, scale and ratios, height, length movement. Some examples include:

History:
- Learn about the history of telling time in Bhutan before watches or clocks were available in telling time using diverse indigenous ways.
- Learn how various cultures told time throughout history and write a report.
- Calculate the number of years between various events.
- Learn about the history of currency.

Geography:
- Calculate the actual distance between various cities, states or countries using ratio and proportion.
- Learn to read grid coordinates and find places on a map through the use of latitude and longitude.
- Use a map scale to determine the distances between two points on a map to learn about the connection between scale and actual distance.
- Create replicas of famous buildings, monuments, or structures using the idea of perimeter, area, and volume.

Social Studies:
- Draw bar graphs to compare populations, per capita income, population density, etc. of various countries.
- Figure out the percentages of people that speak various languages in Bhutan.
- Learn about the different types of currencies and their conversions.

Economics and Commerce
- Financial literacy and its importance to daily living.
- Calculate taxes - income tax, sales tax, discounts, etc.
- Banking and calculating interest in different types of accounts, calculating interests on loans etc.
- Calculating sales price, interest, commission percentages etc.
- Practice counting money, writing invoices etc.

Bibliography

Boaler, Jo (2015), *Mathematical Mindsets: Unleashing Students' Potential through Creative Math, Inspiring Messages and Innovative Teaching*, 1st Edition.

California Department of Education (CDE), (2015), *Mathematics Framework* http://www.corestandards.org/wp-content/uploads/Math_Standards1.pdf, retrieved 16 November 2020.

Inter-American Development Bank (2020), *Learning Mathematics in the 21st Century Adding Technology to the Equation*, IDB.

Kindergarten Through Class Twelve for California Public Schools, CDE.

Liljedahl, Peter, (2021), *Building Thinking Classrooms in Mathematics Classes K-12, 14 Teaching Practices for Enhancing Learning*, Corwin Press Inc.

Ministry of Education (MoE), Bhutan (2005), *Mathematics Curriculum Framework for Classes PP-XII*, MoE, Bhutan.

Ministry of Education (MoE), Singapore (2012), *Mathematics Syllabus: Secondary One to Four Express Course Normal (Academic) Course,* MoE, Singapore.

National Council of Teachers of Mathematics (NCTM) (2000), *Principles and Standards for School Mathematics: An Overview*, NCTM.

National Council of Teachers of Mathematics (NCTM) (2014), *Principles to Actions: Ensuring Mathematical Success for All,* NCTM.

Organisation for Economic Co-operation and Development (OECD) (2016), *PISA 2018 Framework*, OEC

Appendix A

Assessment Structures for each Strand

KS- I (Class PP - III)

Key Stage	Assessment					
	Term I			Term II		
	CA	Mid Term Examination	Total	CA	Annual Examination	Total
I	Continuous Formative Assessment					

For both Term I and Term II, assess each competency through appropriate performance tasks and assessment tools.

Performance Tasks: Worksheets, quiz, question and answer, presentation, making models, small projects, etc.

Assessment Tools: checklist, rating scale or rubrics.

Assessment Areas: *Content*: Formulating situations mathematically, applying concepts, facts, and procedures, and interpreting mathematical results.

Skills and attitude: Collaboration, communication, creativity, time management, learning attitude, feedback reception,etc.

KS- II (Class IV - VI)

Key Stage	Assessment									
	Term I					Term II				
	CA (25)			Mid Term Examination	Total	CA (25)			Annual Examination	Total
	CW	HW	PT			CW	HW	PW		
II	10	10	5	25	**50**	10	10	5	25	**50**

For both Term I and Term II, assess each competency through appropriate performance tasks and assessment tools.

Performance Tasks(PT): quiz, question and answer, presentation, making models, small projects, etc.

Project Work(PW): One mandatory project must be completed annually. Refer rubrics and planning sample at the end of IG).

Assessment Tools: checklist, rating scale or rubrics.

Assessment Areas: *Content*: Formulating situations mathematically, applying concepts, facts, and procedures, and interpreting mathematical results.
Skills and attitude: Collaboration, communication, creativity, time management, learning attitude, feedback reception,etc.
NOTE: Project work assessment is mandatory for class IV and VI

KS- III (Class VII - VIII)

Key Stage	Assessment					
	Term I			Term II		
	CA	Mid Term Examination	Total	CA	Annual Examination	Total
III	20	30	50	20	30	50

For both Term I and Term II, assess each competency through appropriate performance tasks and assessment tools.
Performance Tasks: Worksheets, quiz, question and answer, presentation, making models, small projects, etc.
Project Work: One **mandatory** project must be completed annually. Refer rubrics and planning sample at the end of IG).
Assessment Tools: checklist, rating scale or rubrics.
Assessment Areas: *Content*: Formulating situations mathematically, applying concepts, facts, and procedures, and interpreting mathematical results.
Skills and attitude: Collaboration, communication, creativity, time management, learning attitude, feedback reception,etc.

KS-IV (Class IX & X)

Key Stage	Assessment									
	Term I					Term II				
	CA (15)			Mid Term Examination	Total	CA (15)			Annual Examination	Total
	CW	HW	PW			CW	HW	PW		
IV	6	6	3	35	**50**	6	6	3	35	**50**

For both Term I and Term II, assess each competency through appropriate performance tasks and assessment tools.

Performance Tasks: quiz, question and answer, presentation, making models, small projects, etc.

Assessment Tools: checklist, rating scale or rubrics.

Assessment Areas: *Content*: Formulating situations mathematically, applying concepts, facts, and procedures, and interpreting mathematical results.

Skills and attitude: Collaboration, communication, creativity, time management, learning attitude, feedback reception,etc.

NOTE: Project work assessment is mandatory for class IX and X

KS-V (Class XI & XII)

Key Stage	Assessment									
	Term I					Term II				
	CA (10)			Mid Term Examination	Total	CA (10)			Annual Examination	Total
	CW	HW	PW			CW	HW	PW		
V	3	4	3	40	**50**	3	4	3	40	**50**

For both Term I and Term II, assess each competency through appropriate performance tasks and assessment tools.

Performance Tasks: quiz, question and answer, presentation, making models, small projects, etc.

Assessment Tools: checklist, rating scale or rubrics.

Assessment Areas: *Content*: Formulating situations mathematically, applying concepts, facts, and procedures, and interpreting mathematical results.

Skills and attitude: Collaboration, communication, creativity, time management, learning attitude, feedback reception,etc.

NOTE: Project work assessment is mandatory for class XI and XII

Appendix B

Weighting and Time Allocations for each Strand

Key stage II (Class IV - VI)

Strand	Time Allocation (Mins.)			Weighting(%)		
	IV	V	VI	IV	V	VI
Strand A: Numbers and Operations	3750	3250	3000	45	39	37
Strand B: Patterns and Algebra	550	900	750	7	10	10
Strand C: Measurement	1000	1400	1350	12	17	17
Strand D: Geometry	1900	1700	1550	22	20	20
Strand E: Data and Probability	1200	1150	1250	14	14	16

Key stage III (Class VII - VIII)

Strand	Time Allocation (Mins.)		Weighting(%)	
	VII	VIII	VII	VIII
Strand A: Numbers and Operations	3000	2150	42	30
Strand B: Patterns and Algebra	950	1050	13	14
Strand C: Measurement	1100	1600	15	22
Strand D: Geometry	1200	1600	17	22
Strand E: Data and Probability	950	800	13	12

Key Stage IV (Class IX & X)

Strand	Time Allocation (Mins.)		Weighting(%)	
	IX	X	IX	X
Strand A: Numbers and Operations	1800	1100	25	19
Strand B: Patterns and Algebra	1800	1600	25	25
Strand C: Measurement	1100	2250	18	27
Strand D: Geometry	1100	650	15	12
Strand E: Data and Probability	1000	1100	17	17

Key Stage V (Class XI & XII)

Strand	Time Allocation (Mins.)				Weighting(%)			
	PMT		BMT		PMT		BMT	
	XI	XII	XI	XII	XI	XII	XI	XII
Strand A: Numbers and Operations	1300	1550	1400	2800	20	20	24	32
Strand B: Patterns and Algebra	2900	2300	3200	2200	40	31	36	32
Strand C: Measurement	450	500	1100	1050	6	7	18	16
Strand D: Geometry	1400	2250			20	26		
Strand E: Data and Probability	1200	1400	1550	1950	14	16	22	20

Appendix C

Sample Class work Assessment Rubrics

Criteria	Exceeding (5)	Advancing (4)	Meeting (3)	Approaching (2)	Beginning (1)
Understanding	→ Demonstrates a deep and thorough understanding of the concepts covered. → Consistently applies knowledge to solve problems.	→ Shows a good understanding of the concepts. → Applies knowledge effectively in most situations.	→ Demonstrates a basic understanding of the concepts. → Struggles with consistent application.	→ Limited understanding of the concepts. → Inconsistently applied knowledge.	→ Minimal understanding of the concept. → Unable to apply knowledge effectively.
Effort and participation	→ Actively engages in class discussions and activities. → Displays an exceptional commitment to learning, actively seeking opportunities to contribute beyond expectations	→ Engages in class activities with enthusiasm. → Demonstrates a strong commitment to learning, willing to take on additional responsibilities when appropriate →	→ Participates at a basic level. → Effort is inconsistent. → Demonstrates a commitment to learning, however lacks consistency in engaging with course content.	→ Shows limited effort and participation. → Often disengaged in class. → Demonstrates a basic commitment to learning, with room for improvement in engagement.	→ Minimal effort and participation Frequently disengaged.
Independence	→ Demonstrates a high level of independence in completing classwork. → Rarely requires assistance.	→ Generally works independently but may seek clarification when needed.	→ Works somewhat independently but often requires assistance.	→ Requires frequent assistance to complete classwork.	→ Constantly relies on others to complete classwork.
Seeking support	→ Proactively seeks support when faced with challenging concepts or problems. → Collaborates effectively with peers and teachers to enhance understanding.	→ Willingly seeks support when needed. → Demonstrates effective collaboration with peers and teachers.	→ Occasionally seeks support but may be hesitant. → Limited collaboration with peers and teachers.	→ Rarely seeks support.- → Minimal collaboration with peers and teachers.	→ Does not seek support. → No collaboration with peers and teachers.
Collaboration	→ Demonstrates excellent collaboration skills in group activities. → Encourages and supports peers, fostering a positive and inclusive class atmosphere	→ Collaborates well with peers in group activities. → Generally fostering a positive class environment.	→ Participates in group activities but with limited collaboration → Inconsistent contributions.	→ Struggles to collaborate effectively in group activities. → Offers occasional contributions, with room for improvement in depth of insights	→ Unable to collaborate effectively. → Rarely contributes ideas or insights to class conversations.

Sample Homework Assessment Rubrics

Criteria	Exceeding (5)	Advancing (4)	Meeting (3)	Approaching (2)	Beginning (1)
Understanding	➜ Demonstrates a deep and thorough understanding of the homework assigned. ➜ Consistently applies knowledge to solve problems.	➜ Shows a good understanding of the homework concepts. ➜ Applies knowledge effectively in most situations.	➜ Demonstrates a basic understanding of the homework concepts. ➜ Struggles with consistent application.	➜ LLimited understanding of the homework concepts. ➜ Inconsistently applies knowledge.	➜ Minimal understanding. Unable to apply knowledge effectively.
Completion	➜ All homework are completed accurately and thoroughly.- ➜ Consistently submits high-quality work.	➜ Most homework tasks are completed accurately and thoroughly. ➜ Few minor errors present.	➜ Some homework tasks are completed accurately, but there are notable gaps. ➜ Several errors are present.	➜ Numerous incomplete or inaccurately completed homework tasks. ➜ Completion is inconsistent.	➜ Virtually all homework tasks are incomplete or inaccurately completed.
Accuracy of response	➜ All calculations and solutions are accurate and precise. ➜ Demonstrates meticulous attention to detail.	➜ Most calculations and solutions are accurate and precise. ➜ Few minor errors present.	➜ Some calculations and solutions are accurate but lack precision. ➜ Several errors are present.	➜ Numerous errors in calculations and solutions. ➜ Accuracy and precision are major issues.	➜ Virtually all calculations and solutions are incorrect or imprecise.
Neatness and organization	➜ Homework is exceptionally well-organized and neatly presented. ➜ All text is highly legible, and there are no smudges or unintended marks. ➜ Clear headings, labels, and steps enhance the overall organization	➜ Overall organization is good, with a clear presentation. ➜ Most text is legible, and there are minimal smudges or unintended marks. ➜ Headings, labels, and steps contribute to effective organization.	➜ Organization is acceptable but may lack some neatness. ➜ Legibility varies, and there may be occasional smudges or unintended marks. ➜ Clear headings and labels help maintain a basic level of organization	➜ Organization is somewhat lacking, and there is some difficulty in following the work. ➜ Legibility issues are noticeable, and there are frequent smudges or unintended marks. ➜ Headings and labels are consistently not clear.	➜ Poor organization makes it challenging to follow the homework. ➜ Legibility is compromised, and there are significant smudges or unintended marks throughout. ➜ Chaotic presentation hinders understanding, and headings and labels may be unclear or absent.
Follow up and improvement	➜ Actively seeks feedback on homework.	➜ Open to feedback and uses it to make improvements in	➜ Occasionally seeks feedback but inconsistently	➜ Rarely seeks feedback and seldom makes improvements.	➜ Does not seek feedback or make

		subsequent homework.	incorporates it into subsequent work.		improvements.
	➔ Demonstrates a commitment to improving based on feedback. ➔ Makes corrections and improvements on subsequent submissions.	➔ Shows a willingness to learn from mistakes.	➔ Limited improvement over time.	➔ Little evidence of learning from mistakes.	➔ Repeated mistakes persist
Timeline	➔ Submits homework/assignments consistently on time.	➔ Generally submits homework on time but may occasionally be late.	➔ Submits homework somewhat late on a regular basis.	➔ Frequently submits homework late.	➔ Consistently submits homework/ assignments late.

➔ Demonstrates a commitment to improving based on feedback.
➔ Makes corrections
subsequent homework.
➔ Shows a willingness to learn from mistakes.
incorporates it into subsequent work.
➔ Limited improvement