PHYSICS

CURRICULUM FOR SECONDARY EDUCATION (SHS 1 - 3)

NaCCA

NATIONAL COUNCIL FOR CURRICULUM & ASSESSMENT OF MINISTRY OF EDUCATION

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FOREWORD

Through the National Council for Curriculum and Assessment (NaCCA), Ghana's Ministry of Education has introduced a series of curriculum reforms to improve the quality and relevance of learning experiences in pre-tertiary schools in the country. These reforms will improve learning through the introduction of innovative pedagogies that encourage critical thinking and problem-solving. For a long time, our learners memorise facts and figures, which does not develop their analytical and practical skills. The Ministry recognises that learners need to be equipped with the right tools, knowledge, skills and competencies to deal with the fast-changing environment and the challenges facing their communities, the nation and the world.

These curriculum reforms were derived from the Education Strategic Plan (ESP 2018-2030), the National Pre-tertiary Education Curriculum Framework (NPTECF) and the National Pre-Tertiary Learning Assessment Framework (NPLAF), which were all approved by Cabinet in 2018. The new standards-based curriculum implemented in 2019 in basic schools, aims to equip learners to apply their knowledge innovatively to solve everyday problems. It also prioritises assessing learners' knowledge, skills, attitudes, and values, emphasising their achievements. The content of the basic school standards-based curriculum was therefore designed to promote a curriculum tailored to the diverse educational needs of the country's youth. It addresses the current curriculum's deficiencies in learning and assessment, especially in literacy and numeracy. These reforms have been carried out in phases. The curriculum for the basic school level – KG, Primary and Junior High School (JHS) – was developed and implemented from 2019 to 2021.

The curriculum for Senior High School (SHS), Senior High Technical School (SHTS) and Science, Technical, Engineering and Mathematics (STEM), which constitutes the next phase, is designed to ensure the continuation of learning experiences from JHS. It introduces flexible pathways for progression to facilitate the choice of subjects necessary for further study, the world of work and adult life. The new SHS, SHTS and STEM curriculum emphasises the acquisition of 21st Century skills and competencies, character development and instilling of national values. Social and Emotional Learning (SEL), Information Communications Technology, Gender Equality and Social Inclusion, have all been integrated into the curriculum. Assessment – formative and summative has been incorporated into the curriculum and aligned with the learning outcomes throughout the three-year programme.

The Ministry of Education's reform aims to ensure that graduates of our secondary schools can successfully compete in international high school competitions and, at the same time, be equipped with the necessary employable skills and work ethos to succeed in life. The Ministry of Education, therefore, sees the Senior High School (SHS) curriculum as occupying a critical place in the education system – providing improved educational opportunities and outcomes for further studies, the world of work and adult life – and is consequently prioritising its implementation.

ACKNOWLEDGEMENTS

This standards-based SHS curriculum was created using the National Pre-Tertiary Learning Assessment Framework (NPLAF), the Secondary Education Assessment Guide (SEAG), and the Teacher and Learner Resource Packs which include Professional Learning Community (PLC) Materials and Subject Manuals for teachers and learners. All the above-mentioned documents were developed by the National Council for Curriculum and Assessment (NaCCA). The Ministry of Education (MoE) provided oversight and strategic direction for the development of the curriculum with NaCCA receiving support from multiple agencies of the MoE and other relevant stakeholders. NaCCA would like to extend its sincere gratitude, on behalf of the MoE, to all its partners who participated in the professional conversations and discussions during the development of this SHS curriculum.

In particular, NaCCA would also like to extend its appreciation to the leadership of the Ghana Education Service (GES), the National School Inspectorate Authority (NaSIA), the National Teaching Council (NTC), the Commission for Technical and Vocational Education and Training (Commission for TVET), West African Examinations Council (WAEC) and other agencies of the MoE that supported the entire process. In addition, NaCCA acknowledges and values the contributions made by personnel from various universities, colleges of education Industry players, Vice Chancellors Ghana, Vice Chancellors Technical Universities as well as educators and learners working within the Ghana education landscape.

Special appreciation is extended to consultants who contributed to development of the curriculum. The development process involved multiple engagements between national stakeholders and various groups with interests in the curriculum. These groups include the teacher unions, the Association of Ghana Industries, and heads of secondary schools.

CONTENTS

THE SHS CURRICULUM OVERVIEW

The vision for this curriculum is to ensure the nation has a secondary education system that enables all Ghanaian children to acquire the 21st Century skills, competencies, knowledge, values and attitudes required to be responsible citizens, ready for the world of work, further studies and adult life. The nation's core values drive the SHS curriculum, and it is intended to achieve Sustainable Development Goal 4: 'Inclusive, equitable quality education and life-long learning for all'. Above all, it is a curriculum enabling its graduates to contribute to the ongoing growth and development of the nation's economy and well-being.

The curriculum is inclusive, flexible, and robust. It was written under the auspices of the National Council for Curriculum and Assessment by a team of expert curriculum writers across Ghana. It reflects the needs of critical stakeholders, including industry, tertiary education, the West African Examination Council, SHS learners, teachers, and school leaders. It has been written based on the National Pre-Tertiary Learning and Assessment Framework and the Secondary Education Policy.

The key features of the curriculum include:

- flexible learning pathways at all levels, including for gifted and talented learners and those with deficiencies in numeracy and literacy, to ensure it can meet the needs of learners from diverse backgrounds and with different interests and abilities.
- the five core learning areas for secondary education: science and technology, language arts, humanities, technical and vocational and business; with emphasis placed on STEM and agriculture as integral to each subject.
- a structured, standards-based approach that supports the acquisition of knowledge, skills and competencies, and transition and seamless progress throughout secondary education, from JHS to SHS and through the three years of SHS.
- a focus on interactive approaches to teaching and assessment to ensure learning goes beyond recall enabling learners to acquire the ability to understand, apply, analyse and create.
- guidance on pedagogy, coupled with exemplars, demonstrating how to integrate cross-cutting themes such as 21st Century skills, core competencies, the use of ICT, literacy and mathematics, Social Emotional Learning, Gender Equality and Social Inclusion as tools for learning and skills for life. Shared Ghanaian values are also embedded in the curriculum.

The curriculum writing process was rigorous and involved developing and using a Curriculum Writing Guide which provided systematic instructions for writers. The process was quality assured at three levels: through (a) evaluation by national experts, (b) trialling curriculum materials in schools and (c) through an external evaluation by a team of national and international experts. Evidence and insights from these activities helped hone the draft's final version. The outcome is a curriculum coherently aligned with national priorities, policies and the needs of stakeholders. A curriculum tailored to the Ghanaian context ensures that all learners benefit from their schooling and develop their full potential.

The following section highlights the details of the front matter of the draft curriculum. The vision, philosophy and goal of the curriculum are presented. This is followed by the details of the 21st Century skills and competencies, teaching and learning approaches, instructional design and assessment strategies. The template for the curriculum frame, which outlines the scope and sequence, the design that links the learning outcomes to particular 21st Century skills and competencies, as well as Gender Equality and Social Inclusion, Social and Emotional Learning and Ghanaian values are presented together with the structure of the lesson frame showing the links between the content standards, learning indicators with their corresponding pedagogical exemplars and assessment strategies.

INTRODUCTION

Effective implementation of this Senior High School (SHS) curriculum is the key to creating a well-educated and well-balanced workforce that is ready to contribute to Ghana's progress by harnessing the potential of the growing youth population, considering the demographic transition the country is currently experiencing (Educational Strategic Plan [ESP] 2018-2030). SHS curriculum aims to expand equitable, inclusive access to relevant education for all young people, including those in disadvantaged and underserved communities, those with special educational needs and those who are gifted and talented. Senior High School allows young people to develop further skills and competencies and progress in learning achievement, building from the foundation laid in Junior High School. This curriculum intends to meet the learning needs of all high school learners by acquiring 21st Century skills and competencies to prepare them for further studies, the world of work and adult life. Changing global economic, social and technological context requires life-long learning, unlearning, and continuous processes of reflection, anticipation and action.

Philosophy of Senior High School Curriculum

The philosophy underpinning the SHS curriculum is that every learner can develop their potential to the fullest if the right environment is created and skilled teachers effectively support them to benefit from the subjects offered at SHS. Every learner needs to be equipped with skills and competencies of interest to further their education, live a responsible adult life or proceed to the world of work.

Vision of Senior High School Curriculum

The vision of the curriculum is to prepare SHS graduates equipped with relevant skills and competencies to progress and succeed in further studies, the world of work and adult life. It aims to equip all learners with the 21st Century skills and competencies required to be responsible citizens and lifelong learners. When young people are prepared to become effective, engaging, and responsible citizens, they will contribute to the ongoing growth and development of the nation's economy and well-being.

Goal of Senior High School Curriculum

The goal of the curriculum is to achieve relevant and quality SHS through the integration of 21st Century skills and competencies as set out in the Secondary Education Policy. The key features to integrate into the curriculum are:

- Foundational Knowledge: literacy, numeracy, scientific literacy, information, communication and digital literacies, financial literacy and entrepreneurship, cultural identity, civic literacy and global citizenship
- Competencies: critical thinking and problem-solving, innovation and creativity, collaboration, and communication
- Character Qualities: discipline, integrity, self-directed learning, self-confidence, adaptability and resourcefulness, leadership, and responsible citizenship.

The JHS curriculum has been designed to ensure that learners are adequately equipped to transition seamlessly into SHS, where they will be equipped with the relevant knowledge, skills and competencies. The SHS curriculum emphasises character building, acquisition of 21st Century skills and competencies and nurturing core values within an environment of quality education to ensure the transition to further study, the world of work and adult life. This requires the delivery of robust secondary education that meets the varied learning needs of the youth in Ghana. The SHS curriculum, therefore, seeks to develop learners to become technology-inclined, scientifically literate, good problem-solvers who can think critically and creatively and are equipped to communicate with fluency, and possess the confidence and competence to participate fully in Ghanaian society as responsible local and global citizens – (referred to as 'Glocal citizens').

The SHS curriculum is driven by the nation's core values of truth, integrity, diversity, equity, discipline, self-directed learning, self-confidence, adaptability and resourcefulness, leadership, and responsible citizenship, and with the intent of achieving the Sustainable Development Goal 4: 'Inclusive, equitable quality education and life-long learning for all'. The following sections elaborate on the critical competencies required of every SHS learner:

Gender Equality and Social Inclusion (GESI)

- Appreciate their uniqueness about others.
- Pay attention to the uniqueness and unique needs of others.
- Value the perspective, experience, and opinion of others.
- Respect individuals of different beliefs, political views/ leanings, cultures, and religions.
- Embrace diversity and practise inclusion.
- Value and work in favour of a democratic and inclusive society.
- Be conscious of the existence of minority and disadvantaged groups in society and work to support them.
- Gain clarity about misconceptions/myths about gender, disability, ethnicity, age, religion, and all other excluded groups in society
- Interrogate and dispel their stereotypes and biases about gender and other disadvantaged and excluded groups in society.
- Appreciate the influence of socialisation in shaping social norms, roles, responsibilities, and mindsets.
- Identify injustice and advocate for change.
- Feel empowered to speak up for themselves and be a voice for other disadvantaged groups.

21st Century Skills and Competencies

In today's fast-changing world, high school graduates must be prepared for the 21st Century world of work. The study of Mathematics, Science, and Language Arts alone is no longer enough. High school graduates need a variety of skills and competencies to adapt to the global economy. Critical thinking, creativity, collaboration, communication, information literacy, media literacy, technology literacy, flexibility, leadership, initiative, productivity, and social skills are needed. These skills help learners to keep up with today's fast-paced job market. Employers want workers with more than academic knowledge. The 21st Century skills and competencies help graduates navigate the complex and changing workplace. Also, these help them become active citizens who improve their communities. Acquisition of 21st Century skills in high school requires a change in pedagogy from the approach that has been prevalent in Ghana in recent years. Teachers should discourage and abandon rote memorisation and passive learning. Instead, they should encourage active learning, collaboration, and problem-solving, project-based, inquiry-based, and other learner-centred pedagogy should be used. As well as aligning with global best practices, these approaches also seek to reconnect formal education in Ghana with values-based indigenous education and discovery-based learning which existed in Ghana in pre-colonial times. This is aligned with the 'glocal' nature of this curriculum, connecting with Ghana's past to create confident citizens who can engage effectively in a global world. Digitalisation, automation, technological advances and the changing nature of work globally mean that young people need a new set of skills, knowledge and competencies to succeed in this dynamic and globalised labour market.

Critical Thinking and Problem-Solving Competency

- Ability to question norms, practices, and opinions, to reflect on one's values, perceptions, and actions.
- Ability to use reasoning skills to come to a logical conclusion.
- Being able to consider different perspectives and points of view
- Respecting evidence and reasoning
- Not being stuck in one position
- Ability to take a position in a discourse
- The overarching ability to apply different problem-solving frameworks to complex problems and develop viable, inclusive, and equitable solution options that integrate the above-mentioned competencies, promote sustainable development,

Creativity

- Ability to identify and solve complex problems through creative thinking.
- Ability to generate new ideas and innovative solutions to old problems.
- Ability to demonstrate originality and flexibility in approaching tasks and challenges.
- Collaborating with others to develop and refine creative ideas
- Ability to incorporate feedback and criticism into the creative process
- Utilising technology and other resources to enhance creativity
- Demonstrating a willingness to take risks and experiment with new approaches
- Adapting to changing circumstances and further information to maintain creativity

- Integrating multiple perspectives and disciplines to foster creativity
- Ability to communicate creative ideas effectively to a variety of audiences

Collaboration

- Abilities to learn from others; to understand and respect the needs, perspectives, and actions of others (empathy)
- Ability to understand, relate to and be sensitive to others (empathic leadership)
- Ability to deal with conflicts in a group
- Ability to facilitate collaborative and participatory problem-solving
- Ability to work with others to achieve a common goal.
- Ability to engage in effective communication, active listening, and the ability to compromise.
- Ability to work in groups on projects and assignments.

Communication

- Know the specific literacy and language of the subjects studied
- Use language for academic purposes
- Communicate effectively and meaningfully in a Ghanaian Language and English Language
- Communicate confidently, ethically, and effectively in different social contexts.
- Communicate confidently and effectively to different participants in different contexts
- Ability to communicate effectively verbally, non-verbally and through writing.
- Demonstrate requisite personal and social skills that are consistent with changes in society
- Ability to express ideas clearly and persuasively, listen actively, and respond appropriately
- Ability to develop digital communication skills such as email etiquette and online collaboration.
- Ability to engage in public speaking, debate, and written communication.

Learning for Life

- Understand subject content and apply it in different contexts
- Apply mathematical and scientific concepts in daily life
- Demonstrate mastery of skills in literacy, numeracy, and digital literacy.
- Develop an inquiry-based approach to continual learning.
- Be able to understand higher-order concepts and corresponding underlying principles.
- Participate in the creative use of the expressive arts and engage in aesthetic appreciation.
- Use and apply a variety of digital technologies
- Be digitally literate with a strong understanding of ICT and be confident in its application.
- Be equipped with the necessary qualifications to gain access to further and higher education and the world of work and adult life
- Ability to apply knowledge practically in the workplace so that they are able to utilise theory by translating it into practice.
- Develop their abilities, gifts and talents to be able to play a meaningful role in the development of the country
- Be able to think critically and creatively, anticipate consequences, recognise opportunities and be risk-takers
- Ability to pursue self-directed learning with the desire to chart a path to become effective lifelong learners.
- Independent thinkers and doers who show initiative and take action.
- Ability to innovate and think creatively, building on their knowledge base so that they take risks to achieve new goals
- Ability to think critically and solve problems so that they become positive change agents at work, in further study and in their personal lives.
- Be motivated to adapt to the changing needs of society through self-evaluation and ongoing training
- Be able to establish and maintain innovative enterprises both individually and in collaboration with others.
- Be able to ethically prioritise economic values to ensure stability and autonomy
- Show flexibility and preparedness to deal with job mobility
- Be committed towards the improvement of their quality of life and that of others
- Feel empowered in decision-making processes at various levels e.g., personal, group, class, school, etc.

- Be able to seek and respond to assistance, guidance and/or support when needed.
- Ability to make and adhere to commitments.
- Adopt a healthy and active lifestyle and appreciate how to use leisure time well.
- Be enthusiastic, with the knowledge, understanding and skill that enable them to progress to tertiary level, the world of work and adult life.
- Ability to transition from school to the world of work or further study by applying knowledge, skills and attitudes in new situations.
- Be independent, have academic and communication skills such as clarity of expression (written and spoken), and the ability to support their arguments.
- Be innovative and understand the 21st Century skills and competencies and apply them to everyday life.

Global and Local (Glocal) Citizenship

- Appreciate and respect the Ghanaian identity, culture, and heritage
- Be conscious of current global issues and relate well with people from different cultures
- Act in favour of the common good, social cohesion and social justice
- Have the requisite personal and social skills to handle changes in society
- Appreciate the impact of globalisation on the society.
- Ability to be an honest global citizen displaying leadership skills and moral fortitude with an understanding of the wider world and how to enhance Ghana's standing.

Systems Thinking Competency

- Ability to recognise and understand relationships
- Ability to analyse complex systems
- Ability to think of how systems are embedded within different domains and different scales
- Ability to deal with uncertainty

Normative Competency

- Ability to understand and reflect on the norms and values that underlie one's actions
- Ability to negotiate values, principles, goals, and targets, in a context of conflicts of interests and trade-offs, uncertain knowledge and contradictions

Anticipatory Competency

- Ability to understand and evaluate multiple futures – possible, probable, and desirable
- Ability to create one's vision for the future.
- Ability to apply the precautionary principle
- Ability to assess the consequences of actions
- Ability to deal with risks and changes

Strategic Competency

- Ability to collectively develop and implement innovative actions that further a cause at the local level and beyond.
- Ability to understand the bigger picture and the implications of smaller actions on them

Self-Awareness Competency

- The ability to reflect on one's role in the local community and (global) society
- Ability to continually evaluate and further motivate one's actions
- Ability to deal with one's feelings and desires

Social Emotional Learning (SEL): Five Core Competencies with Examples

1. *Self-Awareness*

Understanding one's emotions, thoughts, and values and how they influence one's behaviour in various situations. This includes the ability to recognise one's strengths and weaknesses with a sense of confidence and purpose. For instance:

- *Integrating personal and social identities;*
- *Identifying personal, cultural, and linguistic assets;*
- *Identifying one's emotions;*
- *Demonstrating honesty and integrity;*
- *Connecting feelings, values, and thoughts;*

- *Examining prejudices and biases;*
- *Experiencing self-efficacy;*
- *Having a growth mindset;*
- *Developing interests and a sense of purpose;*

2. *Self-Management*

The capacity to control one's emotions, thoughts, and actions in a variety of situations and to realise one's ambitions. This includes delaying obtaining one's desires, dealing with stress, and feeling motivated and accountable for achieving personal and group goals. For instance:

- *Managing one's emotions;*
- *Identifying and utilising stress-management strategies;*
- *Demonstrating self-discipline and self-motivation;*
- *Setting personal and group goals;*
- *Using planning and organisation skills;*
- *Having the courage to take the initiative;*
- *Demonstrating personal and collective agency;*

3. *Social Awareness*

The capacity to comprehend and care for others regardless of their backgrounds, cultures, and circumstances. This includes caring for others, understanding larger historical and social norms for behaviour in different contexts, and recognising family, school, and community resources and supports. For instance:

- *Recognising others' strengths*
- *Demonstrating empathy and compassion*
- *Caring about others' feelings*
- *Understanding and expressing gratitude*
- *Recognising situational demands and opportunities*
- *Understanding how organisations and systems influence behaviour*

4. *Relationship Skills*

The capacity to establish and maintain healthy, beneficial relationships and adapt to various social situations and groups. This includes speaking clearly, listening attentively, collaborating, solving problems and resolving conflicts as a group, adapting to diverse social and cultural demands and opportunities, taking the initiative, and asking for or offering assistance when necessary. For instance:

- *Communicating effectively;*
- *Building positive relationships;*
- *Demonstrating cultural competence;*
- *Working as a team to solve problems;*
- *Constructively resolving conflicts;*
- *Withstanding negative social pressure;*
- *Taking the initiative in groups;*
- *Seeking or assisting when needed;*
- *Advocating for the rights of others.*

5. *Responsible Decision-Making*

The capacity to make thoughtful and constructive decisions regarding acting and interacting with others in various situations. This includes weighing the pros and cons of various personal, social, and group well-being actions. For example:

- *Demonstrating curiosity and an open mind;*
- *Solving personal and social problems;*
- *Learning to make reasonable decisions after analysing information, data, and facts;*
- *Anticipating and evaluating the effects of one's actions;*
- *Recognising that critical thinking skills are applicable both inside and outside of the classroom;*
- *Reflecting on one's role in promoting personal, family, and community well-being;*
- *Evaluating personal, interpersonal, community, and institutional impacts*

Learning and Teaching Approaches

Learning and teaching should develop learners as self-directed and lifelong learners. Learners must be helped to build up deep learning skills and competencies to develop the ability to acquire, integrate and apply knowledge and skills to solve authentic and real-life problems. Learners need to be exposed to a variety of learning experiences to enable them to collaborate with others, construct meaning, plan, manage, and make choices and decisions about their learning. This will allow them to internalise newly acquired knowledge and skills and help them

to take ownership of their education. The 21st Century skills and competencies describe the relevant global and contextualised skills that the SHS curriculum is designed to help learners acquire in addition to the 4Rs (Reading, wRiting, aRithmetic and cReativity). These skills and competencies, as tools for learning and teaching and skills for life, will allow learners to become critical thinkers, problem-solvers, creators, innovators, good communicators, collaborators, digitally literate, and culturally and globally sensitive citizens who are life-long learners with a keen interest in their personal development and contributing to national development.

Given the diverse needs of learners, teachers need to have a thorough grasp of the different pedagogies as they design and enact meaningful learning experiences to meet the needs of different learners in the classroom. The teaching-learning techniques and strategies should include practical activities, discussion, investigation, role play, problem-based, context-based, and project-based learning. Active learning strategies have become increasingly popular in education as they provide learners with meaningful opportunities to engage with the material. These strategies emphasise the use of creative and inclusive pedagogies and learner-centred approaches anchored on authentic and enquiry-based learning, collaborative and cooperative learning, differentiated teaching and learning, holistic learning, and cross-disciplinary learning. They include experiential learning, problem-based learning, project-based learning, and talk-for-learning approaches. Some of the pedagogical exemplars to guide learning and teaching of the SHS curriculum include:

- **Experiential Learning:** Experiential learning is a hands-on approach to learning that involves learners in real-world experiences. This approach focuses on the process of learning rather than the result. Learners are encouraged to reflect on their experiences and use them to develop new skills and knowledge. Experiential learning can take many forms, including internships, service learning, and field trips. One of the main benefits of experiential learning is that it allows learners to apply what they have learned in the classroom to real-world situations. This can help them develop a deeper understanding of the material and make connections between different concepts. Additionally, experiential learning can help learners develop important skills such as critical thinking, problem-solving and communication.
- **Problem-Based Learning:** Problem-based learning is an approach that involves learners in solving real-world problems. Learners are presented with a problem or scenario and are asked to work together to find a solution. This approach encourages learners to take an active role in their learning and helps them develop important skills such as critical thinking and problem-solving. One of the main benefits of problem-based learning is that it encourages learners to take ownership of their learning. By working together to solve problems, learners can develop important skills such as collaboration and communication. Additionally, problem-based learning can help learners develop a deeper understanding of the material as they apply it to real-world situations.
- **Project-Based Learning:** Project-based learning is a hands-on approach to learning that involves learners in creating a project or product. This approach allows learners to take an active role in their learning and encourages them to develop important skills such as critical thinking, problem-solving, collaboration, and communication. One of the main benefits of project-based learning is that it allows learners to apply what they have learned in the classroom to real-world situations. Additionally, project-based learning can help learners develop important skills from each other and develop a deeper understanding of the material.
- **Talk for Learning Approaches:** Talk for learning approaches (TfL) are a range of techniques and strategies that are used to encourage learners to talk by involving them in discussions and debates about the material they are learning. This approach encourages learners to take an active role in their learning and helps them develop important skills such as critical thinking, collaboration and communication and also makes them develop confidence. One of the main benefits of TfL is that it encourages learners to think deeply about the material they are learning. By engaging in discussions and debates, learners can develop a deeper understanding of the material and make connections between different concepts.
- **Initiating Talk for Learning:** Initiating talk for learning requires the use of strategies that would encourage learners to talk in class. It helps learners to talk and participate meaningfully and actively in the teaching and learning process. Apart from developing skills such as communication and critical thinking, it also helps learners to develop confidence. Some strategies for initiating talk among learners are Activity Ball; Think-Pair-Share; Always, Sometimes, Never True; Matching and Ordering of Cards.
- **Building on What Others Say:** Building on what others say is an approach that involves learners in listening to and responding to their classmates'

ideas. This approach encourages learners to take an active role in their learning and helps them develop important skills such as critical thinking and communication. One of the main benefits of building on what others say is that it encourages learners to think deeply about the material they are learning. By listening to their classmates' ideas, learners can develop a deeper understanding of the material and make connections between different concepts. Additionally, building on what others say can help learners develop important skills such as collaboration and reflection. Some of the strategies to encourage learners to build on what others say are brainstorming, concept cartoons, pyramid discussion, and 5 Whys, amongst others.

- **Managing Talk for Learning:** Managing talk for learning requires the use of various strategies to effectively coordinate what learners say in class. Effective communication is a crucial aspect of learning in the classroom. Teachers must manage talk to ensure that learners are engaged, learning, and on-task in meaningful and purposeful ways. Some strategies for managing learners' contributions are debates, think-pair-share, sage in the circle etc.
- **Structuring Talk for Learning:** One effective way to shape learners' contributions is to structure classroom discussions. Structured discussions provide a framework for learners to engage in meaningful dialogue and develop critical thinking skills. Teachers can structure discussions by providing clear guidelines, such as speaking one at a time, listening actively, and building on each other's ideas. One popular structured discussion technique is the "think-pair-share" method. In this method, learners think about a question or prompt individually, and then pair up with a partner to discuss their ideas. Finally, the pairs share their ideas with the whole class. This method encourages all learners to participate and ensures that everyone has a chance to share their thoughts. Another effective way to structure talk for learning is to use open-ended questions. Open-ended questions encourage learners to think deeply and critically about a topic. They also promote discussion and collaboration among learners. Teachers can use open-ended questions to guide classroom discussions and encourage learners to share their ideas and perspectives. Other strategies that can be used are Concept/Mind Mapping, "Know," "Want to Know," "Learned" (KWL); Participatory Feedback; and the 5 Whys.
- **Diamond Nine:** The Diamond Nine activity is a useful tool for managing talk for learning in the classroom. This activity involves ranking items or ideas in order of importance or relevance. Learners work in groups to arrange cards or sticky notes with different ideas or concepts into a diamond shape, with the most important idea at the top and the least important at the bottom. The Diamond Nine activity encourages learners to think critically about a topic and prioritise their ideas. It also promotes collaboration and discussion among group members. Teachers can use this activity to introduce a new topic, review material, or assess student understanding.
- **Group Work/Collaborative Learning:** Group work or collaborative learning are effective strategies for managing talk for learning in the classroom. These strategies encourage learners to work together to solve problems, share ideas, and learn from each other. Group work and collaborative learning also promote communication and collaborative skills that are essential for success in the workplace and in life. To implement group work effectively, teachers must provide clear guidelines and expectations for group members. They should also monitor group work to ensure that all learners are participating and on-task. Teachers can also use group work as an opportunity to assess individual student understanding and participation.
- **Inquiry-Based Learning:** Learners explore and discover new information by asking questions and investigating.
- **Problem-Based Learning:** Learners are given real-world problems to solve and must use critical thinking and problem-solving skills.
- **Project-Based Learning:** Learners work on long-term projects that relate to real-world scenarios.
- **Flipped Classroom:** Learners watch lectures or instructional videos at home and complete assignments and activities in class.
- **Mastery-Based Learning:** Learners learn at their own pace and only move on to new material once they have mastered the current material.
- **Gamification:** Learning is turned into a game-like experience with points, rewards, and competition.

These strategies provide learners with opportunities to engage with the material in meaningful ways and develop important skills such as critical thinking, problem-solving, collaboration, and communication. By incorporating these strategies into their teaching, teachers can help learners develop a deeper understanding of the material and prepare them for success in the real world. Effective communication is essential for learning in the classroom. Teachers must manage talk to ensure that learners are engaged in learning and on-task. Strategies such as structuring

talk for learning, using Diamond Nine activities, and implementing group work/ collaborative learning can help teachers manage talk effectively and promote student learning and engagement. By implementing these strategies, teachers can create a positive and productive learning environment where all learners can succeed.

Universal Design for Learning (UDL) in the SHS Curriculum

The design of the curriculum uses UDL to ensure the creation of flexible learning environments that can accommodate a wide range of learner abilities, needs, and preferences. The curriculum is designed to provide multiple means of engagement, representation, and action and expression, so teachers can create a more inclusive and effective learning experience for all learners. UDL is beneficial for all learners, but it is particularly beneficial for learners needing special support and learners who may struggle with traditional teaching approaches. The integration of UDL in the pedagogy is aimed at making learning accessible to everyone and helping all learners reach their full potential. For instance, teachers need to:

- incorporate multiple means of representation into their pedagogy, such as using different types of media and materials to present information.
- provide learners with multiple means of action and expression, such as giving them options for how they can demonstrate their learning.
- consider incorporating multiple means of engagement into their choice of pedagogy, such as incorporating games or interactive activities to make learning more fun and engaging.

By doing these, teachers can help ensure that the curriculum is accessible and effective for all learners, regardless of their individual needs and abilities.

Curriculum and Assessment Design: Revised Bloom's Taxonomy and Webb's Depth of Knowledge

The design of this curriculum uses the revised Bloom's Taxonomy and Webb's Depth of Knowledge (DoK) as frameworks to design what to teach and assess.

The Revised Bloom's Taxonomy provides a framework for designing effective learning experiences. Understanding the different levels of learning, informed the creation of activities and assessments that challenge learners at the appropriate level and help them progress to higher levels of thinking. Additionally, the framework emphasises the importance of higher-order thinking skills, such as analysis, evaluation, and creation, which are essential for success in today's complex and rapidly changing world. This framework is a valuable tool for educators who want to design effective learning experiences that challenge students at the appropriate level and help them develop higher-order thinking skills. By understanding the six levels of learning and incorporating them into their teaching, educators can help prepare students for success in the 21st century. The six hierarchical levels of the revised Bloom's Taxonomy are:

1. **Remember** – At the foundation is learners' ability to remember. That is retrieving knowledge from long-term memory. This level requires learners to recall concepts—identify, recall, and retrieve information. Remembering is comprised of identifying, listing, and describing. Retrieving relevant knowledge from long-term memory includes, recognising, and recalling is critical for this level.
2. **Understand** – At understanding, learners are required to construct meaning that can be shown through clarification, paraphrasing, representing, comparing, contrasting and the ability to predict. This level requires interpretation, demonstration, and classification. Learners explain and interpret concepts at this level.
3. **Apply** – This level requires learners' ability to carry out procedures at the right time in a given situation. This level requires the application of knowledge to novel situations as well as executing, implementing, and solving problems. To apply, learners must solve multi-step problems.
4. **Analyse** – The ability to break things down into their parts and determine relationships between those parts and being able to tell the difference between what is relevant and irrelevant. At this level, information is deconstructed, and its relationships are understood. Comparing and contrasting information and organising it is key. Breaking material into its constituent parts and detecting how the parts relate to one another and an overall structure or purpose is required. The analysis also includes differentiating, organising and attributing.
5. **Evaluate** – The ability to make judgments based on criteria. To check whether there are fallacies and inconsistencies. This level involves information evaluation, critique, examination, and formulation of hypotheses.
6. **Create** – The ability to design a project or an experiment. To create, entails learners bringing something new. This level requires generating information—planning, designing, and constructing.

Webb's Depth of Knowledge (DoK) is a framework that helps educators and learners understand the level of cognitive engagement required for different types of learning tasks. The framework includes four levels. By understanding the four DoK levels, educators can design learning activities that challenge students to engage in deeper thinking and problem-solving. DoK is an essential tool for designing effective instruction and assessments. By understanding the different levels of DoK, teachers can design instruction and assessments that align with what they intend to achieve. DoK is a useful tool for differentiating instruction and providing appropriate challenges for all learners. Teachers can use DOK to identify students who need additional support or those who are ready for more advanced tasks. The four levels of Webb's' DoK assessment framework are:

- **Level 1: Recall and Reproduction –** Assessment at this level is on recall of facts, concepts, information, and procedures—this involves basic knowledge acquisition. Learners are asked specific questions to launch activities, exercises, and assessments. The assessment is focused on recollection and reproduction.
- **Level 2: Skills of Conceptual Understanding –** Assessment at this level goes beyond simple recall to include making connections between pieces of information. The learner's application of skills and concepts is assessed. The assessment task is focused more on the use of information to solve multi-step problems. A learner is required to make decisions about how to apply facts and details provided to them.
- **Level 3: Strategic Reasoning** – At this level, the learner's strategic thinking and reasoning which is abstract and complex is assessed. The assessment task requires learners to analyse and evaluate composite real-world problems with predictable outcomes. A learner must apply logic, employ problem-solving strategies, and use skills from multiple subject areas to generate solutions. Multitasking is expected of learners at this level.
- **Level 4: Extended Critical Thinking and Reasoning –** At this level of assessment, the learner's extended thinking to solve complex and authentic problems with unpredictable outcomes is the goal. The learner must be able to strategically analyse, investigate, and reflect while working to solve a problem, or changing their approach to accommodate new information. The assessment requires sophisticated and creative thinking. As part of this assessment, the learner must know how to evaluate their progress and determine whether they are on track to a feasible solution for themselves.

The main distinction between these two conceptual frameworks is what is measured. The revised Bloom's Taxonomy assesses the cognitive level that learners must demonstrate as evidence that a learning experience occurred. The DoK, on the other hand, is focused on the context—the scenario, setting, or situation—in which learners should express their learning. In this curriculum, the revised Bloom's taxonomy guided the design, and the DoK is used to guide the assessment of learning. The taxonomy provides the instructional framework, and the DoK analyses the assignment specifics. It is important to note that Bloom's Taxonomy requires learners to master the lower levels before progressing to the next. So, suppose the goal is to apply a mathematical formula. In that case, they must first be able to identify that formula and its primary purpose (remember and understand). The cognitive rigour is therefore presented in incremental steps to demonstrate the learning progression. When measuring assessments in DoK, learners move fluidly through all levels. In the same example, while solving a problem with a formula, learners recall the formula (DoK 1) to solve the problem (DoK 2 and DoK 3). Depending on the difficulty of the problem to be solved, the learner may progress to DoK 4.

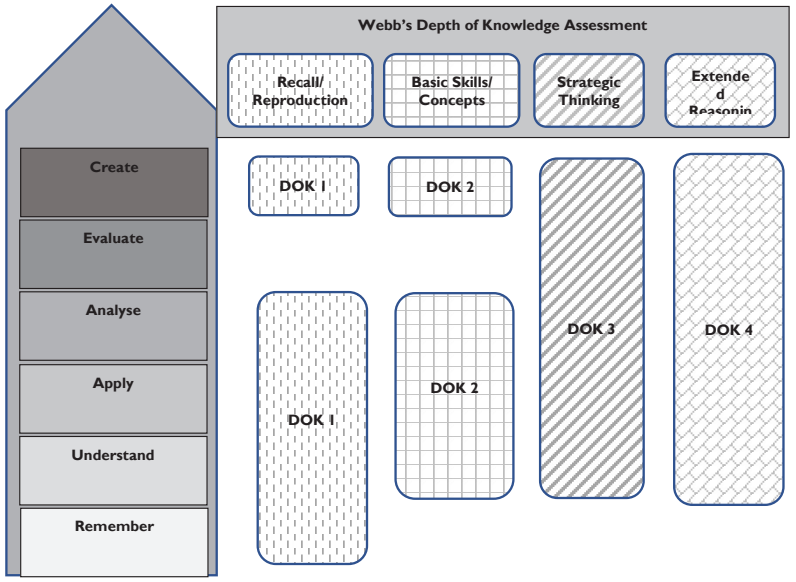

Figure 1: Revised Bloom Taxonomy combined with Webb's Depth of Knowledge for Teaching and Assessment

The structure of teaching and the assessment should align with the six levels of Bloom's knowledge hierarchy and DoK shown in Figure 1. Each level of DoK should be used to assess specific domains of Bloom's Taxonomy as illustrated in the table below:

Depth of Knowledge (DoK) Assessment	Bloom's Taxonomy applied to DoK
• Level 1: Recall and Reproduction	• Remembering, Understanding, Application, Analysis and Creation
• Level 2: Basic Skills and Concepts	• Understanding, Application, Analysis and Creation
• Level 3: Strategic Thinking	• Understanding, Application, Analysis, Evaluation and Creation
• Level 4: Extended Reasoning	• Understanding, Application, Analysis, Evaluation and Creation

In line with the National Pre-Tertiary Learning and Assessment Framework, the Secondary Education Assessment Guide (SEAG) requires that classroom assessments should cover **Assessment as learning (AaL), Assessment of learning (AoL) and Assessment for learning (AfL).** Therefore, teachers should align the Revised Bloom's Taxonomy with the DoK framework of assessment. Formative assessments should include classroom discussions, project-based assignments, and self-reflection exercises, while summative assessments should include standardised tests and rubric-based evaluations of learners' work. It is important to seek feedback from learners themselves, as they may have unique insights into how well they are developing these skills in the classroom.

To assess 21st Century skills and competencies in the classroom, teachers will have to use a combination of both formative and summative assessments to evaluate learners' acquisition of these skills and competencies. For instance:

- Identify the specific 21st Century skills and competencies to be assessed. For instance, you might want to assess *critical thinking, problem-solving, or creativity*.
- Align the skills and competencies with the DoK levels. For example, lower DoK levels might be more appropriate for assessing basic knowledge and comprehension, whereas higher DoK levels might be more appropriate for assessing more complex skills such as *analysis, synthesis, and evaluation*.
- Develop assessment items that align with the DoK levels and the skills and competencies you want to assess. These items should be designed to elicit evidence of learning across the different levels of the DoK framework.
- Administer the assessment and collect data. Analyse the data to gain insights into student learning and identify areas where learners may need additional support or instruction.

The DoK framework is a powerful tool for assessing the acquisition of 21st Century skills and competencies in the classroom, helping teachers to better understand how learners are learning and identify areas for improvement.

Educational success is no longer about producing content knowledge, but rather about extrapolating from what we know and applying the knowledge creatively in new situations.

The overall assessment of learning at SHS should be aligned with the National Pre-Tertiary Learning and Assessment Framework and the Secondary Education Assessment Guide. Formative and summative assessment strategies must be used.

Definition of Key Terms and Concepts in the Curriculum

- **Learning Outcomes:** It is a statement that defines the knowledge, skills, and abilities that learners should possess and be able to demonstrate after completing a learning experience. They are specific, measurable, attainable, and aligned with the content standards of the curriculum. It helps the teachers to determine what to teach, how to teach, and how to assess learning. Also, it communicates expectations to learners and helps them to better master the subject.
- **Learning Indicators:** They are measures that allow teachers to observe progress in the development of capacities and skills. They provide a simple and reliable means to evaluate the quality and efficacy of teaching practices, content delivery, and attainment of learning outcomes.
- **Content Standards:** It is a statement that defines the knowledge, skills, and understanding that learners are expected to learn in a particular subject area or grade level. They provide a clear target for learners and teachers and help focus resources on learner achievement.
- **Pedagogical Exemplars:** They are teaching examples used to convey values and standards to learners. Pedagogical Exemplars are usually demonstrated through teacher behaviour.
- **Assessment:** It is the systematic collection and analysis of data about learners' learning to improve the learning process or make a judgement on learner achievement levels. Assessment is aimed at developing a deep understanding of what learners know, understand, and can do with their knowledge because of their educational experiences. Assessment involves the use of empirical data on learners' learning to improve learning. Assessment is an essential aspect of the teaching and learning process in education, which enables teachers to assess the effectiveness of their teaching by linking learner performance to specific learning outcomes.
- **Teaching and Learning Resources:** Teaching and learning resources are essential tools for teachers to provide high-quality education to their learners. These resources can take various forms, including textbooks, audiovisual materials, online resources, and educational software. It is also important to avoid stereotypes and use inclusive language in teaching and learning resources. This means avoiding language that reinforces negative stereotypes and using language that is respectful and inclusive of all individuals regardless of their background. Using a consistent tone, style, and design is very important.

PHILOSOPHY, VISION AND GOAL OF PHYSICS

Philosophy

The next generation of scientists is empowered through critical and creative thinking by understanding the theoretical and practical application of related concepts in physics that leverage hands-on activities within a global environment.

Vision

To equip physics learners with 21st-century skills and competencies through hands-on experimentation, analysis and discovery of basic concepts in physics and science for sustainable development.

Goal

To prepare and equip physics learners through scientific inquiry, discovery, and teaching to improve scientific literacy and exhibit scientific dispositions to build competencies and skills for individual aspiration and national development.

Contextual Issues

The study of physics has mostly been considered abstract and difficult by most learners in SHSs. Consequently, learners have not gained the desired proficiency to relate physics concepts to everyday life applications. The content they also learn reflects very little of the Ghanaian context, as pedagogy and assessment tend to focus on memorisation instead of giving them the required skills to be problem solvers. The learner of the 21st century will require skill sets that encourage the learner to know and understand the basics of physics, analyse concepts and discover solutions that contribute to society's social, historical, environmental, technological and economic life. They should be competent in measuring physical quantities and use scientific equipment and experimental data appropriately. Learners should also be able to explain the basic science underlying familiar facts and appreciate the many vocational applications of physics.

It is imperative that issues such as Gender Equality and Social Inclusion (GESI) and Shared National Values (SNV) are incorporated into the teaching of physics so that learners respect and appreciate diversity and appreciate that learning physics also demands respect for values. Issues of content overload, using other resources such as virtual laboratories, simulations, videos and science sets, are addressed through pedagogies and assessments, which do not limit the teacher's creativity and innovation. The teacher can utilise opportunities such as field trips in the community and project and problem-based learning to appreciate the applications of physics in the community.

Rationale

The new curriculum aims at positive reforms that promotes understanding and analysis of concepts, and scientific literacy that promotes the vocational application of physics. The new curriculum also recommends the use of learner-centred and practical pedagogical approaches, collaborative work, creativity, critical thinking, communication and ICT tools, to improve teaching and learning based on the achievement of skills and competencies.

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SCOPE AND SEQUENCE

Physics Summary

S/N	STRAND	SUB-STRAND	YEAR 1			YEAR 2			YEAR 3		
			CS	LO	LI	CS	LO	LI	CS	LO	LI
1	Mechanics and Matter	Introduction to Basic Physics	2	2	8	3	3	7	3	3	13
		Matter	1	1	2	1	1	4	-	-	-
		Kinematics	1	1	3	2	2	7	1	1	4
		Dynamics	2	2	6	1	1	2	1	1	3
2	Energy	Heat	1	1	4	1	1	4	1	1	3
		Waves	3	3	10	2	2	8	2	2	6
3	Electric Field, Magnetic Field And Electronics	Electrostatics, Direct Current	2	2	7	2	2	9	3	3	7
		Magnetostatics, Alternating Current	1	1	3	3	3	10	2	2	6
		Analogue Electronics, Electromagnetic Induction & Applications	3	3	9	3	3	9	3	3	9
		Applications of Electronics	-	-	-	-	-	-	3	3	7
4	Atomic and Nuclear Physics	Atomic Physics	1	1	2	1	1	3	1	1	4
		Nuclear Physics	1	1	3	1	1	3	1	1	3
Total			18	18	57	20	20	66	21	21	65

Overall Totals (SHS 1 – 3)

Content Standards	59
Learning Outcomes	59
Learning Indicators	188

YEAR ONE

Subject **PHYSICS**
Strand **1. MECHANICS AND MATTER**
Sub-Strand **1. INTRODUCTION TO PHYSICS**

Learning Outcomes	21st Century Skills and Competencies	GESI[1], SEL[2] and Shared National Values
1.1.1.LO.1		
Explain how physics is applied in some sectors of the glocal economy	**Digital Learning:** By employing the use of ICT devices to watch video learners acquire and develop their digital literacy. **Collaborating and communication:** In mixed-ability groups learners learn to be team players as they share ideas to relate physics to various industrial sectors	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other collaboratively, cross-sharing knowledge and understanding among groups and individuals lead them to: • Appreciate the skills and abilities of everyone in the global environment. • Examine and dispel misconceptions/ myths about gender and disabilities related to Physics. • Interrogate their stereotypes and biases about how both genders have contributed to the development of Physics and career and academic prospects. **SEL:** Learners, through their interactions with colleagues and the support provided by teachers as they learn the application of Physics in the various sectors of the economy, helps them to: • Develop strategies for completing a task

[1] Gender Equality and Social Inclusion
[2] Socio-Emotional Learning

		or learning new concepts. • Demonstrate respect for diversity among learners and find ways to share their cultural backgrounds and experiences. • Evaluate various real-world scenarios and make decisions based on the information. **National Core Values:** • Honesty • Teamwork • Resilience • Integrity • Responsibility • Respect
1.1.1.LO.2		
Classify quantities into fundamental, derived, scalars, and vectors	**Collaboration and communication:** In mixed-ability groups, learners talk to one another to come out with the uncertainties of the various instrument. **Critical thinking:** Learners will employ their knowledge in mathematics to simplify and deduce the units of quantities. **Communication and collaboration:** Learners will have to talk to one another to establish the relationship between quantities. **Creativity and Problem-solving:** Learners learn how to solve problems by manipulating to figure out the proper usage of instruments and also learn to overcome challenges they will encounter in the handling of the instruments Provide equitable access to physics resources, equipment, technology, and opportunities for hands-on experiments or projects, ensuring all students have equal access to Learning resources and experiences.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Appreciate the skills and abilities of everyone. • Encourage diverse perspectives and contributions. **SEL:** Learners through their interactions with colleagues and the support provided by teachers as they classify physical quantities in Physics, helps them to: • Develop strategies for completing a task or learning new concepts. • Foster creative problem-solving skills. **National Core Values:**

		• Honesty • Altruism • Resilience • Respect • Responsibility • Leadership

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
1.1.1.CS.1	1.1.1.LI.1	1.1.1.AS.1
Demonstrate knowledge and understanding of the characteristics of physics as exhibited in everyday life.	**Identify careers that are related to physics in various sectors of the economy.** **Collaborative learning:** • Let learners watch a documentary showing how physics through collaboration and critical thinking plays a vital role in the world. • Learners through talk for learning discuss how careers in plumbing, carpentry, welding, vulcanising, masonry is physics oriented careers. • Learners discuss physics-oriented careers such as engineering (mechanical, civil, geomatic, electrical), medicine and new areas such as geophysics, materials science, metallurgy, laser physics, radiology, astrophysics, meteorology and climate science and others play vital role in the world. • Learners appreciate that success in physics-oriented careers like all others require hard work and resilience. For a physicist, it is important to report observations as seen without personal biases and requires focus. Grouping be mindful of gender, where applicable. Learners who are not adept in Mathematics and/or in using some digital equipment should be catered. Learners should appreciate that Physics oriented careers are open to everyone. Provide students with exposure to diverse perspectives and opportunities to engage with professionals who challenge stereotypes and promote inclusive practices in physics.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.1.1.LI.2	1.1.1.AS.2
	Use basic mathematical concepts to solve problems - trigonometric ratios, Pythagoras's theorem, sine and cosine rule, indices. **Deductive learning:** • Learners recall relevant previous knowledge on plane geometrical figures such as triangles and trapeziums and also determine their area. • Let learners employ the sine and cosine rules in the determination of the sides and angles within triangles.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning

	• Let learners also employ the Pythagoras's theorem in deducing angles of inclined objects for example staking of plants, using ladders on walls, etc. • Learners recall relevant knowledge on indices and determine the number of teams remaining per stage at the World Cup with a maximum number of 32 teams. Grouping being mindful of gender, where applicable. Learners who are not adept in mathematics and/or in using some digital equipment should be catered. Learners should appreciate that physics-oriented careers are open to everyone. Provide equitable access to resources and opportunities.		
Teaching and Learning Resources	• Reference materials, • Internet • Computers	• Audio visuals • Community visits. i.e., universities, industries research institutes.	• Basic laboratory resources • Calculators

Content Standards	Learning Indicators and Pedagogical Exemplars with 21St Century and GESI	Assessment
1.1.1.CS.2	1.1.1.LI.1	1.1.1.AS.1
Demonstrate knowledge and understanding of physical quantities.	**Identify the basic units in physics.** **Talk for learning:** Let learners come out with some derived units and their quantities by brainstorming. i. e. guide them to identify the basic units and their quantities. Ensure that the teaching materials, examples, and illustrations reflect diverse perspectives.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.1.1.LI.2	1.1.1.AS.2
	Determine the dimensions of physical quantities (velocity, acceleration, mass, length, time, weight, energy, force). **Collaborative learning:** • Let learners identify the relationship between quantities such as density, speed/velocity, acceleration, force, work, pressure, power and the basic quantities i. e. mass, length, and time. • Let learners replace the independent quantities i. e. mass, length, and time with their respective dimensions in physics texts. • Let learners deduce the units of measurement of the dependent quantities. Encourage the appreciation and valuing of the skills and abilities of individuals from diverse backgrounds, including gender, race, ethnicity, socioeconomic status, and disabilities.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.1.1.LI.3	1.1.1.AS.3
	Identify the errors in the use of meter rule, protractor, electronic balance, vernier calliper and the micrometer screw gauge. **Think pair share** • Let learners in pairs measure length, diameter, angles, mass and width of various items that can be found in the lab with meter rule, protractor, electronic balance, vernier calliper and the micrometer screw gauge. • Let learners compare their values.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning

	• Let learners identify the differences in the measurements. Foster respect and inclusion in physics, creating an inclusive and welcoming classroom environment that values the contributions of individuals from all backgrounds and genders.	Level 4 Extended critical thinking and reasoning
	1.1.1.LI.4	1.1.1.AS.4
	Explain the types of errors - systematic, random and parallax **Talk for Learning:** Discuss the various types of errors and let learners group the errors made in their respective measurement into systematic, random, and parallax errors. Recognise diverse talents and perspectives.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.1.1.LI.5	1.1.1.AS.5
	Explain scientific notation and their unit multipliers. **Talk for learning:** Discuss with learners the various scientific notation, their symbols and unit multiplier and let learners know their relevance in expressing quantities. Foster an inclusive and respectful classroom culture and address bias in teaching materials and examples.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.1.1.LI.6	1.1.1.AS.6
	Distinguish scalars from vectors (qualitative treatment) **Collaborative learning:** Let learners find out the differences between scalars and vectors and let them in mixed-ability groups and categorise velocity, acceleration, mass, length, time, weight, energy, power and force into scalars and vectors. Encourage self-awareness and personal growth by fostering an environment where learners feel comfortable sharing their reflections and experiences.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning

			Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Meter rule • Protractor	• Electronic balance • Vernier calliper and	• Micrometer screw gauge

Subject **PHYSICS**
Strand **1. MECHANICS AND MATTER**
Sub-Strand **2. MATTER**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
1.1.2.LO.1		
Explain the various states of matter and the differences in their structure	**Digital Learning:** By employing the use of ICT devices to watch video learners acquire and develop digital literacy. **Collaborating and Communication:** In mixed-ability groups, learners learn to be team players as they share ideas and identify the various states and their differences.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Avoid perpetuating stereotypes, biases, or exclusionary language that may reinforce gender or social inequities. • Demonstrate respect for diverse perspectives, experiences, and identities in physics. **SEL:** Learners through their interactions with colleagues and the support provided by teachers as they learn the different states of matter, helps them to: Contribute constructively to discussions and actively listen to peers' ideas. Acquire strategies to manage emotions, maintain focus and regulate behaviour during physics activities. **National Core Values:** • Honesty • Altruism • Resilience

		• Respect • Responsibility • Leadership

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI			Assessment
1.1.2.CS.1	1.1.2.LI.1			1.1.2.AS.1
Demonstrate knowledge and understanding of matter	**Identify the various states of matter.** **Collaborative learning:** Let learners watch a simulation/video for them to come out with the various states of matter through discussion. Ensure that the teaching materials, examples, and illustrations reflect diverse perspectives.			**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.1.2.LI.2			1.1.2.AS.2
	Distinguish between the molecular arrangement of the various states. **Talk for Learning:** Extend the discussion from three states to four states i.e., solid, liquid, gas and plasma. Discussion should look at the molecular arrangement of the various states. Foster respect and inclusion in physics, creating an inclusive and welcoming classroom environment that values the contributions of individuals from all backgrounds and genders.			**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• PhET interactive simulations • Audio-visuals	• Internet • Projectors	• YouTube • Interactive virtual laboratory	

Subject **PHYSICS**
Strand **1. MECHANICS AND MATTER**
Sub-Strand **3. KINEMATICS**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
1.1.3.LO.1		
Explain the terminologies and measurement of distance, displacement, speed, velocity, acceleration, average velocity, instantaneous velocity and distinguish between them.	**Collaborating and communication:** In mixed-ability groups, learners learn to be team players as they share ideas in the discussion of the types of motion. **Critical thinking:** Learners will think and brainstorm to establish the 1st equation of motion from the definition of acceleration. **Creativity and problem-solving:** Learners employ mathematical abilities their manipulative skills to establish the other equations.	**GESI**: Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Facilitate opportunities to share their diverse perspectives, experiences, and ideas in physics discussions and activities. • Engage in self-reflection, examining their biases and assumptions about gender and social inclusion in physics. **SEL:** Learners through their interactions with colleagues and the support provided by teachers as they learn about physical quantities, which helps them to: • Develop strategies for completing a task or learning new concepts. • Demonstrate respect for diversity among learners and finding ways to share their cultural backgrounds and experiences. • Evaluate various real-world scenarios

		and make decisions based on the information. **National Core Values:** • Tolerance • Compassion

Content Standards	Learning Indicators and Pedagogical Exemplars with 21St Century and GESI	Assessment
1.1.3.CS.1	1.1.3.LI.1	1.1.3.AS.1
Demonstrate knowledge and understanding of motion and its relevance to everyday activities.	**Describe the various types of motion i.e., circular, oscillatory, rectilinear, spin, and random.** **Talk for learning**: Let learners discuss and come out with the various types of motion and discuss with learners to come out with the meaning the terminologies associated with motion. Recognise diverse talents and perspectives.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.1.3.LI.2	1.1.3.AS.2
	Establish equations of uniformly accelerated motion and its application in daily life. **Talk for learning:** • Learners brainstorm and define the terminologies distance, displacement, speed, velocity, acceleration, average velocity, instantaneous velocity and distinguish between them. • Relate average speed to total distance travelled and time taken to cover the distance. i.e., s/t = (u + v)/2 • Employ the definition of acceleration to establish v = u + at. • Guide learners to establish the other two equations by manipulating exemplars 1 & 2. • Learners must be told that the value of "g" replaces acceleration "a" for motion under gravity.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	1.1.3.LI.3	1.1.3.AS.3
	Represent the motion of objects graphically i.e., distance-time, displace-time, and velocity-time and deductions that can be made from it. **Talk for learning:** • Let learners discuss how the motion of object can be represented graphically. • Learners must determine the slope of the graph as well as the area under the graph • Learners give the significance of the slope and the area under the graph. Ensure that the teaching materials, examples, and illustrations reflect diverse perspectives.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning

Teaching and Learning Resources	• Audio-visuals • Internet	• Projectors • YouTube	• Interactive virtual laboratory

Subject **PHYSICS**
Strand **1. MECHANICS AND MATTER**
Sub-Strand **4. DYNAMICS**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
1.1.4.LO.1		
Apply the laws of motion to explain how bodies change their positions.	**Critical Thinking:** Learners will analyse the situation and come out with suggestions. **Communication and Collaboration**: Learners will listen and accept divergent views from peers. **Digital Literacy skills** of learners are developed through the use of ICT.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Foster critical thinking and discussions around societal gender stereotypes, biases, and misconceptions related to physics. • Avoid perpetuating stereotypes, biases, or exclusionary language that may reinforce gender or social inequities. **SEL:** Learners through their interactions with colleagues and the support provided by teachers as they learn about motion and its relationship to everyday life, helps them to: • Develop strategies for completing a task or learning new concepts. • Demonstrate respect for diversity among learners and finding ways to share their cultural backgrounds and experiences.

		• Provide opportunities for learners to evaluate various real-world scenarios and make decisions based on the information. **National Core Values:** • Teamwork • Resilience
1.1.4.LO.2		
Recognise pressure as an agent of force.	**Digital Learning** by employing the use of ICT devices to watch video. **Critical thinking collaborating and communication:** In mixed-ability groups by relating daily activities into the three laws of motion	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Appreciate the skills and abilities of everyone. • Examine and challenge societal gender stereotypes and biases that may limit or discourage certain genders from pursuing physics. **SEL:** Learners through their interactions with colleagues and the support provided by teachers as they learn Physics, which helps them to: • Develop effective problem solving strategies to complete tasks and learning new concepts. • Advocate their ideas and solutions in a respectful and self-assured manner. • Evaluate the credibility and validity of scientific information.

		National Core Values: • Honesty • Altruism • Resilience • Respect • Responsibility

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
1.1.4.CS1	1.1.4.LI.1	1.1.4.AS.1
Demonstrate knowledge and understanding of Newton's laws of motion.	**State Newton's laws of motion.** **Talk for learning:** A vehicle has broken down and as responsible citizens, you know that the vehicle needs to be moved off the road to prevent other cars from crashing into it. Explain using Newton's laws of motion using the following: i. To move the vehicle, the force applied must overcome the inertia of the body (1st Law). ii. The change of speed of the vehicle is dependent on the force being applied (2nd Law). iii. The force applied to the vehicle by those pushing it is equal to the force applied by vehicle on those pushing it (3rd Law). Learners build simple paper boats and place them in a bowl of water and using made-up paddles, try to move the paper boats. Learners record their observations and using Newton's laws of motion explain the movement of their boats. Foster an inclusive and respectful classroom culture and address bias in teaching materials and examples.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.1.4.LI.2	1.1.4.AS.2
	Apply Newton's second law to establish the relationship between force, mass and acceleration. **Talk for learning:** Use the discussions from the above situation to establish the 2nd law to derive F = ma. Guide students to interrogate their stereotypes and biases.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.1.4.LI.3	1.1.4.AS.3
	Identify daily applications of Newton's laws of motion.	Level 1 Recall

	Experiential Learning: Let learners watch a video showing various applications of Newton's laws of motion. Put learners in mixed-ability groups for them to classify some activities in daily life into the three laws. Foster collaborations that broaden students' exposure to diverse physics-related career paths and role models.			**Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Audio-visuals • PhET interactive simulations	• Trolley • tennis ball	• soccer ball	

Content Standards	Learning Indicators and Pedagogical Exemplars with 21St Century and GESI	Assessment
1.1.4.CS.1	1.1.4.LI.1	1.1.4.AS.1
Demonstrate knowledge and understanding of pressure.	**Explain how pressure changes with depth in a fluid.** **Experiential learning:** • Learners create three equidistant holes on the same side of a bottle and using water and dirty oil, record their observations of how pressure changes with depth. • Learners draw conclusions based on their observation of the experiment and compare to Pascal's principles. Provide learners with exposure to diverse perspectives and opportunities to challenge stereotypes and promote inclusive practices in physics.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.1.4.LI.2	1.1.4.AS.2
	Explain the operation of brake systems in vehicles and the operation of the hydraulic press. Ask learners to watch a video of the braking systems of cars and the hydraulic press. Employ the services of an auto mechanic if necessary. Engage learners in discussions and activities that examine prevalent myths or misconceptions surrounding gender and disabilities in the context of physics, encouraging critical thinking and dispelling these misconceptions through evidence-based exploration.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	1.1.4.LI.3	1.1.4.AS.3
	State Pascal's principle. Let learners brainstorm to state Pascal's principle from the video/simulation Encourage the appreciation and valuing of the skills and abilities of individuals from diverse backgrounds, including gender, race, ethnicity, socioeconomic status, and disabilities.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning

Teaching and Learning Resources	• Audio-visuals • Internet	• Projectors • YouTube	• Interactive virtual laboratory

Subject **PHYSICS**
Strand **2. ENERGY**
Sub-Strand **1. HEAT**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
1.2.1.LO.1		
Apply the principles of thermometry to design a thermometer.	**Digital Learning:** By employing the use of ICT devices to watch video. Critical thinking, collaboration and communication in mixed-ability groups.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Examine and dispel misconceptions/ myths about gender and disabilities as they relate to Physics. • Interrogate their stereotypes and biases about how both genders have contributed to the development of Physics and career and academic prospects. **SEL:** Learners through their interactions with colleagues and the support provided by teachers as they learn the principles of thermometry, helps them to: • Develop strategies for completing a task or learning new concepts. • Demonstrate respect for diversity among learners and finding ways to share their cultural backgrounds and experiences.

		• Provide opportunities for learners to evaluate various real-world scenarios and make decisions based on the information. **National Core Values:** • Courage • Respect • Diversity

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
1.2.1.CS.1	1.2.1.LI.1	1.2.1.AS.1
Demonstrate knowledge and understanding of principles of Thermometry	**Discuss the thermometric substances and properties and their associated characteristics.** **Explain thermometric substances and their associated characteristics.** **Experiential and Collaborative learning**. • Learners recall previous knowledge on heat and temperature. • Learners in mixed-ability groups of 5, record their observations as one student places the finger in cold water then in warm water. • Learners using a thermometer gun or liquid in glass thermometer measure the degree of hotness or coldness of the two substances. • Learners discuss their observations and give reasons for their observations. • Learners relate their reasons to the properties and characteristics of thermometric substances. • Learners identify the various types of thermometric substances. Ensure that the teaching materials, examples, and illustrations reflect diverse perspectives.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.2.1.LI.2	1.2.1.AS.2
	Describe the features and uses of different types of thermometers. **Talk for learning:** Let learners discuss the uses of the various types of thermometers from the video/simulation they watched. Foster an inclusive and supportive learning environment.	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
	1.2.1.LI.3	1.2.1.AS.3
	Describe the various temperature scales and the construction of their corresponding thermometers. **Talk for learning:** Let learners watch a video/simulation on the operating principle of thermometers such as the thermoelectric, resistance and relate them to the Celsius scale using the exemplar for the preceding indicator.	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning

	Ensure that the teaching materials, examples, and illustrations reflect diverse perspectives.		**Level 4 Extended critical thinking and reasoning**
	1.2.1.LI.4		1.2.1.AS.4
	Derive the relationship between the Celsius, Fahrenheit and the Kelvin scales. **Talk for learning:** Using the internet/reference books Let learners research to find the meaning of the following terms lower fixed point, upper fixed point, and fundamental interval. • Let learners brainstorm to come out with materials and properties that are used to measure temperature. • From the research let learners connect the lower fixed and upper fixed point of different scales to establish temperature relationship. Encourage self-awareness and personal growth by fostering an environment where learners feel comfortable sharing their reflections and experiences.		Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Laboratory thermometers • Beakers • Water • Heaters	• power sources • Audio-visuals • Internet • Reference books	• Projectors • Interactive virtual laboratory • YouTube .

Subject **PHYSICS**
Strand **2. ENERGY**
Sub-Strand **2. WAVES**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
1.2.2.LO.1		
Explain the formation of images in plane mirrors	**Digital Learning:** Employing the use of ICT devices to watch video. **Critical thinking:** Learners will analyse the situation and come out with observations. **Collaboration and communication:** Learners will listen and accept divergent views from peers.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Interrogate their stereotypes and biases about how both genders have contributed to the development of Physics and career and academic prospects. • Actively work towards personal growth and overcoming these biases, promoting self-awareness and empathy. **SEL:** Learners through their interactions with colleagues and the support provided by teachers as they learn how images are formed using plane mirrors, helps them to: • Develop strategies for completing a task or learning new concepts. • Demonstrate respect for diversity among learners and finding ways to share their cultural backgrounds and experiences. • Evaluate various real-world scenarios and make decisions based on the information.

		National Core Values: • Leadership • Honesty • Sustainability
1.2.2.LO.2		
Distinguish between images formed by converging and diverging mirrors and their characteristics	**Critical thinking**: Learners will have to think and make meaning out of their findings **Communication and collaboration**: Learners will have to talk to their peers and find out the findings from their peers **Digital literacy:** Learners will learn how to use ICT tools and their skills in ICT usage will be improved. **Critical thinking**: Learners will have to think to identify the rays that are reflected for image formation	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Appreciate the skills and abilities of everyone. • Develop an understanding of gender equality in physics, recognising that all genders have the potential to excel in the field and contribute to scientific advancements. **SEL:** Learners through their interactions with colleagues and the support provided by teachers as they learn the characteristics of converging and diverging mirrors, helps them to: • Develop strategies for completing a task or learning new concepts. • Demonstrate respect for diversity among learners and finding ways to share their cultural backgrounds and experiences. • Evaluate various real-world scenarios and make decisions based on the information. **National Core Values:** • Courage

		• Respect • Assertiveness
1.2.2.LO.3		
Explain refraction and recognise its relevance in different media.	**Communication and collaboration:** Learners will have to talk to their peers to develop these skills **Critical thinking:** Learners will think and analyse the situation to come out with issues in that concept. **Digital literacy:** Learners will learn how to use ICT tools and their skills in ICT usage will be improved. **Communication and Collaboration:** Learners will have to talk to their peers.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Demonstrate respect for diverse perspectives, experiences, and identities in physics. • Promote an inclusive learning environment that values and respects all voices. **SEL:** Learners through their interactions with colleagues and the support provided by teachers as they learn about reflection on plane mirrors, helps them to: • Communicate their findings in a clear and coherent manner. • Promote evidence-based reasoning. • Promote intellectual humility and openness to alternative perspectives. **National Core Values:** • Courage • Respect • Altruism • Creativity

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
1.2.2.CS.1	1.2.2.LI.1	1.2.2.AS.1
Demonstrate knowledge and understanding of reflection on plane mirrors	**Describe the processes involved in image formation in plane mirrors and their characteristics** **Collaborative learning:** Set up experiment for students in groups of mixed abilities to locate images in a plane mirror. Foster an inclusive and respectful classroom culture and address bias in teaching materials and examples.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.2.2.LI.2	1.2.2.AS.2
	Deduce the laws of reflection. **Experiential learning:** • With the materials provided guide learners to establish the laws of reflection using the images formed by the mirror. • Let learners brainstorm in groups of mixed abilities to establish the link between reflection and image formation. • Guide learners to state the laws of reflection. Foster an inclusive and supportive learning environment.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	1.2.2.LI.3	1.2.2.AS.3
	Determine the number of images formed by inclined mirrors. **Provide learners in mixed-ability groups with 2 mirrors and let them incline to each other to observe the no. of images formed.** • Let learners incline the mirrors at 30°, 45°, 60° and record the number of images in each case. • Let learners divide 360 by the angle of inclination and subtract 1 from the resultant. • Let learners compare their values in exemplars 1 and 2 and come out with a formula for determining the no. of images.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning

	Foster an inclusive and respectful classroom culture and address bias in teaching materials and examples.		
Teaching and Learning Resources	• Plane mirror strip with holder, • Drawing boards, • Optical pins,	• A4 sheets, • Ruler,	• Protractor, • Thumb tugs/drawing pins

Content Standards	Learning Indicators and Pedagogical Exemplars with 21St Century and GESI	Assessment
1.2.2.CS.2	1.2.2.LI.1	1.2.2.AS.1
Demonstrate knowledge and understanding of reflection on spherical mirrors	**Explain the terminologies associated spherical mirrors** **Enquiry learning:** Using the internet/reference books let learners research to find the meaning of the following terms concave mirror, convex mirror, pole, principal focus, centre of curvature, principal axis, focal length, and radius of curvature before watching a video/simulation. Explore contributions of vulnerable groups in the class.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.2.2.LI.1.2	1.2.2.AS1.2
	Describe the processes involved in image formation in spherical mirrors and their characteristics using ray tracing. **Experiential learning:** Let learners watch a video or using simulation see how spherical mirrors form images different images (virtual and real). Learners identify and note the rays that are involved in the image formation process. Provide equitable access to physics resources, equipment, technology, and opportunities for hands-on experiments or projects, ensuring all learners have equal access to Learning resources and experiences.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	1.2.2.LI.3	1.2.2.AS.3
	Determine the position and characteristics of images formed by spherical mirrors with mirror formula and magnification formula. **Experiential learning:** Let learners use the mirror formula with the various conventions (real is positive and cartesian convention) to determine image position, magnification and characteristics. Provide equitable access to physics resources, equipment, technology, and opportunities for hands-on experiments or projects, ensuring all learners have equal access to learning resources and experiences.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning

Teaching and Learning Resources	• Audio-visuals • Spherical mirrors • PhET interactive simulations	• Internet • projectors • YouTube	• Interactive virtual laboratory • Reference books.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
1.2.2.CS.3	1.2.2.LI.1	1.2.2.AS.1
Demonstrate knowledge and understanding of refraction.	**Explain refraction and state the laws of refraction.** **Collaborative learning:** • Ask learners to pour water into a basin and dip a stick or a pencil obliquely into the basin of water and let learners record and discuss their observations. • Let learners place a coin at the bottom of a bowl filled with water and record and discuss their observations. • Learners through simulation or Interactive virtual laboratory, watch how rays are refracted. Guide learners to state the laws of refraction. Promote inclusive language and communication.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	1.2.2.LI.2	1.2.2.AS.2
	Determine the refractive index of a medium. **Think-pair-share:** With the materials provided set up experiment for students to determine the refractive index of a rectangular prism. Exemplars • Determine sin i, sin r, i = angle of incidence r = angle of refraction. • Determine the ratio of sin i to sin r Encourage the appreciation and valuing of the skills and abilities of individuals from diverse backgrounds, including gender, race, ethnicity, socioeconomic status, and disabilities.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	1.2.2.LI.3	1.2.2.AS.3
	Explain total internal reflection. **Collaborative learning:** Put learners into groups of mixed abilities and let them watch a simulation of refraction. Specifically let learners consider situations where the light is moving from a medium of higher density into another of lower density. Learners must take note of observations. Encourage diverse perspectives and contributions.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning**

				Level 4 Extended critical thinking and reasoning
	1.2.2.LI.4			1.2.2.AS.4
	Establish the relationship between the real depth, apparent depth and the refractive index. **Collaborative learning:** Put learners into groups of mixed abilities and let them watch a simulation of how refraction causes apparent displacement of objects at the bottom of a pool of water. Learners must come out with the relationship between the real depth, apparent depth and the refractive index. Explore contributions of vulnerable groups in the class.			Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Bowl/ basin • Stick	• audio-visual projectors • internet	• Interactive virtual laboratory	

Subject **PHYSICS**
Strand **3. ELECTRIC FIELD, MAGNETIC FIELD AND ELECTRONICS**
Sub-Strand **1. ELECTROSTATICS**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
1.3.1.LO.1		
Distinguish between conductors, insulators and semiconductors based on the behaviour of electrons as charge carriers.	**Collaboration and communication:** Learners engage each other in a conversation to develop their communication skills and also support each. **Critical thinking:** Learners will develop this skill through brainstorming. **Digital Learning** by employing the use of ICT devices to watch video learners to acquire and develop digital literacy.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Actively work towards personal growth and overcoming these biases, promoting self-awareness and empathy. • Establish classroom norms and practices that foster respect, empathy, and inclusivity, ensuring all learners feel valued, supported, and free from discrimination or harassment based on gender, race, ethnicity, or ability. **SEL:** Learners through their interactions with colleagues and the support provided by teachers as they learn Physics, which helps them to: • Collaborate effectively in team settings. • Demonstrate adaptability and flexibility in problem-solving processes. • Apply critical thinking skills to analyse

		and evaluate concepts and problems. **National Core Values:** • Teamwork • Inclusion • Respect
1.3.1.LO.2		
Apply the knowledge on charges to describe forces based on like or opposite charges respectively.	**Digital literacy:** Learners learn to use ICT tools thereby developing their digital literacy skills. **Collaboration and Communication:** Learners engage each other in a conversation to develop their communication skills and also support each. **Critical thinking**: Learners will develop this skill through brainstorming.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Appreciate the skills and abilities of everyone. • Interrogate their stereotypes and biases about how both genders have contributed to the development of Physics and career and academic prospects. **SEL:** Learners through their interactions with colleagues and the support provided by teachers as they learn Physics, which helps them to: • Integrate interdisciplinary knowledge and perspectives. • Value diverse contributions and support each other's learning. • Develop strategies for completing a task or learning new concepts.

		National Core Values: • Courage • Respect • Altruism • Creativity

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
1.3.1.CS.1	1.3.1.LI.1	1.3.1.AS.1
Demonstrate knowledge and understanding of the differences between conductors, semiconductor and insulators.	**Explain how the gold leaf electroscope can be used to detect the charge carried by a body**. **Experiential Learning:** • Draw and describe the mode of operation of the gold leaf electroscope to learners. • Learners record their observations as the electroscope is used in a physical or virtual laboratory simulation or watch a video and record their observations. • Recall and identify the types of charges and explain electrical neutrality. • Explain the types of charging - friction/contact, induction and conduction. Provide equitable access to physics resources, equipment, technology, and opportunities for hands-on experiments or projects, ensuring all learners have equal access to Learning resources and experiences.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.3.1.LI.2	1.3.1.AS.2
	Identify electrons as mobile charge carriers. **Talk for learning:** Learners in groups of mixed abilities recall the properties of electrons and analyse their effect on current flow when deficient or in excess. Recognise diverse talents and perspectives.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.3.1.LI.3	1.3.1.AS.3
	Explain how charge carriers in conductors, semiconductors and insulators behave. **Problem-based learning:** • Learners bring random items to class. They identify and categorise items into conductors, semiconductors and insulators. • They discuss the differences between these materials based on the flow of electrons.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning

	Learners appreciate that teamwork is key in exhibiting a material's characteristics. Provide equitable access to resources and opportunities.		
	1.3.1.LI.4		1.3.1.AS.4
	Explain the distribution of charges on surfaces; spherical, pear-shaped and sharp point. **Project-Based learning**: Learners in random groups differentiate how charges are distributed on the various surfaces of conductors and through presentation in any form, explain how a lightning conductor works (PowerPoint presentation, dramatization, cut-outs, flashcards, etc.). Learners appreciate equity as a value as charges are distributed equitably on the surface. Foster an inclusive and supportive learning environment.		Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Gold leaf electroscope, • Combs	• Shreds of paper • Glass rods	• Videos • Interactive virtual laboratory.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
1.3.1.CS.2	1.3.1.LI.1	1.3.1.AS.1
Demonstrate knowledge and understanding of the differences between the two kinds of particles (positive and negative) that are involved in electric interactions.	**Define charge as a fundamental property of matter (like mass).** **Concept/Mind Mapping:** Using concept mind mapping, learners describe the fundamental properties of matter and discuss how charge is a fundamental property (positive, negative and neutral properties). Encourage the appreciation and valuing of the skills and abilities of individuals from diverse backgrounds, including gender, race, ethnicity, socioeconomic status, and disabilities.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.3.1.LI.1.2	1.3.1.AS.1.2
	Explain the conservation of charge and its behaviour. **Concept/Mind Mapping:** Learners discuss the laws of conservation of the fundamental properties of matter and relate it to charges. Encourage the appreciation and valuing of the skills and abilities of individuals from diverse backgrounds, including gender, race, ethnicity, socioeconomic status, and disabilities.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.3.1.LI.1.3	1.3.1.AS.1.3
	Differentiate between the two charges (positive and negative). **Talk for Learning:** Recall and analyse the properties of positive and negative charges. Recognise diverse talents and perspectives.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Videos, • Audio-visuals • PhET interactive simulations • projectors	

Subject **PHYSICS**
Strand **3. ELECTRIC FIELD, MAGNETIC FIELD AND ELECTRONICS**
Sub-Strand **2. MAGNETOSTATICS**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
1.3.2.LO.1		
Use knowledge gained to distinguish between magnetic and non-magnetic materials and explain magnetization and demagnetization.	**Communication and Collaboration:** Learners interact with each other to appreciate the magnetic field generated by a magnet. **Critical thinking**: Learners also develop their Critical thinking skill as they analyse the field generated by the iron fillings and relate them to diagrams on flash cards. **Digital literacy**: Learners learn to use ICT tools to explore for learning	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Demonstrate respect for diverse perspectives and experiences in physics. • Provide opportunities to highlight the contributions and achievements of historically underrepresented groups (including women, racial and ethnic minorities, and individuals with disabilities) in physics. **SEL:** Learners, through their interactions with colleagues and the support provided by teachers as learn magnetism, helps them to: • Value diverse contributions and support each other's learning. • Develop strategies for goal setting.

		National Core Values: • Courage • Respect • Altruism • Creativity • Diligence • Open-mindedness

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
1.3.2.CS.2.1	1.3.2.LI.1.1	1.3.2.AS.1.1
Demonstrate knowledge and understanding of the basics of magnets, magnetization and demagnetization and magnetic field.	**Distinguish between magnets, magnetic and non-magnetic materials.** **Experiential Learning:** • Recall the definition of magnets • In groups of mixed abilities, categorise materials into magnetic and non-magnetic materials using magnets. Provide equitable access to resources and opportunities.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.3.2.LI.1.2	1.3.2.AS.1.2
	Describe the magnetic field. **Experiential Learning:** • In random groups, learners suspend a bar magnet on a thread and retort stand and record their observations. Learners establish the relationship between the geographic north and south and the magnetic north and south based on the orientation of the freely suspended magnet. • Draw and describe magnetic field lines of a magnet using a bar magnet, A4 sheet and iron filings. Indicate points around the magnet where the force is strong and weak. Provide equitable access to resources and opportunities.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.3.2.LI.1.3	1.3.2.AS.1.3
	Describe the processes involved in magnetization and demagnetization. **Experiential Learning:** • Describe how materials are magnetised. Learners should make a solenoid round a nail and connect to a dc source and record their observations as you bring magnetic materials close to the nail in the solenoid. • Describe applications of electromagnets i.e., electric bell, lifting cargo form the harbour. Provide equitable access to resources and opportunities.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning

Teaching and Learning Resources	• Magnetic and non-magnetic materials • Audio-visuals	• Interactive simulations • Magnets	• Iron filings • Flash cards

Subject **PHYSICS**
Strand **3. ELECTRIC FIELD, MAGNETIC FIELD AND ELECTRONICS**
Sub-Strand **3. ANALOGUE ELECTRONICS**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
1.3.3.LO.1		
Explain the basics of semiconductor structure and working principles and their applications in LEDs and Zener diodes.	**Communication and Collaboration:** Learners engage one another through discussion **Critical thinking**: Learners will have to think through observations made by their peers and critique and also offer alternative views. The use of ICT tools helps learners develop their Critical thinking skills	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Establish classroom norms and practices that foster respect, empathy, and inclusivity, ensuring all learners feel valued, supported, and free from discrimination or harassment based on gender, race, ethnicity, or ability. • Examine and dispel misconceptions/ myths about gender and disabilities as they relate to Physics. **SEL:** Learners through their interactions with colleagues and the support provided by teachers as learn about diodes, helps them to: • Demonstrate respect for diversity among learners and finding ways to share their experiences. • Manage their emotions and behaviours effectively to achieve goals and

		aspirations. **National Core Values:** • Teamwork • Inclusion • Respect • Uniqueness
1.3.3.LO.2		
Distinguish between input and output of transducers and show their applications in thermistors, light dependent resistors, infra-red diodes, microphones, buzzers, loudspeakers and electromechanical relays.	**Communication and Collaboration:** Learners must collaboratively engage one another develop the concept. **Critical thinking skills** of learners developed as they critique suggestions from their peers. **Digital literacy:** Learners learn to use ICT tools thereby developing their digital literacy skills.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Appreciate the skills and abilities of everyone. • Examine and dispel misconceptions/ myths about gender and disabilities as they relate to Physics. **SEL:** Learners through their interactions with colleagues and the support provided by teachers as learn transducers, helps them to: • Learn to communicate with diverse individuals and groups. • Demonstrate empathy towards their peers' perspectives and experiences. **National Core Values:** • Patience • Dexterity • Resilience

		• Adaptability
1.3.3.LO.3.1		
Explain the structure and operations of Bipolar Junction Transistors and their applications.	**Communication and Collaboration:** Learners must collaboratively engage one another develop the concept. **Critical thinking skills** of learners developed as they critique suggestions from their peers. **Digital literacy:** Learners learn to use ICT tools thereby developing their digital literacy skills.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Encourage teamwork and cooperation among learners from diverse backgrounds, fostering the development of essential skills for working effectively with individuals from different genders, cultures, and identities. • Avoid perpetuating stereotypes, biases, or exclusionary language that may reinforce gender or social inequities. **SEL:** Learners through their interactions with colleagues and the support provided by teachers as they learn about Transistors and their applications, helps them to: • Develop strategies for completing a task or learning new concepts. • Demonstrate respect for diversity among learners and finding ways to share their cultural backgrounds and experiences.

		• Provide opportunities for learners to evaluate various real-world scenarios and make decisions based on the information. **National Core Values:** • Assertiveness • Ingenuity • Patience • Adaptability

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
1.3.3.CS.1	1.3.3.LI.1	1.3.3.AS.1
Demonstrate knowledge and understanding of the development and functions of diodes	**Describe the formation of the two types of semiconductors: n-type and p-type.** **Concept/Mind Mapping:** • Learners recall the differences between conductors, insulators and semiconductors from Electrostatics and compare with differences using Band Theory. Learners present their observations through Class discussions. • Learners differentiate between intrinsic and extrinsic semiconductors. • Learners describe the formation of the n-type and p-type semiconductors from pentavalent and trivalent atoms respectively. Provide equitable access to physics resources, equipment, technology, and opportunities for hands-on experiments or projects, ensuring all learners have equal access to Learning resources and experiences.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.3.3.LI.2	1.3.3.AS.2
	Describe the basic structure and applications of the PN junction diodes in reverse and forward-biased circuits. **Experiential Learning:** Learners, using LEDs, resistors and a source, discuss forward and reverse biasing and relate it to applications. Encourage diverse perspectives and contributions.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.3.3.LI.1.3	1.3.3.AS.1.3
	Analyse the benefits of using LEDs and I-V characteristics of Zener diodes and applications. **Talk for Learning:** Expound on the benefits using LEDs and from the construction of the I-V characteristics of the Zener diodes. Recognise diverse talents and perspectives.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning

				Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Videos • Interactive simulations	• Flash cards • LEDs,	• Zener diodes	

Content Standards	Learning Indicators and Pedagogical Exemplars with 21St Century and GESI	Assessment
1.3.3.CS.2	1.3.3.LI.1	1.3.3.AS.1
Demonstrate knowledge and understanding of the Input and Output processes of a Transducer	**Explain the terminologies "input" and "output" of a transducer with examples.** **Experiential Learning:** Learners should distinguish between an input and an output and relate it with the transducer. Foster collaborations that broaden students' exposure to diverse physics-related career paths and role models.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.3.3.LI.2	1.3.3.AS.2
	Explain the effect of temperature changes on resistance using a thermistor, light-dependent resistor (LDR), infra-red diode and the microphone and analyse the characteristic graphs of thermistors and LDRs. **Experiential Learning:** Using simulation or laboratory set up or science kit, learners in groups of mixed abilities investigate the effect of temperature changes on resistors in some applications. Ensure that the teaching materials, examples, and illustrations reflect diverse perspectives.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.3.3.LI.3	1.3.3.AS.3
	Describe the processes of the following transducers: microphone, loudspeaker, buzzer, low voltage DC motor, electromagnetic relays and infra - red diodes. **Role Play:** Using role play, explain how the voice of preacher can heard by the congregation in a church. Mechanical wave (sound) -to -transducer microphone - to - Electrical signal (audio signal). Engage learners in discussions and activities that examine prevalent myths or misconceptions surrounding gender and disabilities in the context of physics, encouraging critical thinking and dispelling these misconceptions through evidence-based exploration.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning

Teaching and Learning Resources	• Videos • Interactive simulations	• Flash cards

Content Standards	Learning Indicators and Pedagogical Exemplars with 21St Century and GESI	Assessment
1.3.3.CS.3	1.3.3.LI.1	1.3.3.AS.1
Demonstrate knowledge and understanding of the processes and functions of the Bipolar Junction	**Describe the construction and action of the bipolar junction transistor.** **Project-Based Learning:** Learners in pairs, describe various applications employing BJTs to solve domestic challenges. Learners will draw, complete and label diagrams to explain the construction and processes of a BJT. Encourage self-awareness and personal growth by fostering an environment where learners feel comfortable sharing their reflections and experiences.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.3.3.LI.2	1.3.3.AS.2
	Describe transistor biasing. **Experiential Learning:** Using videos or simulations, learners recall biasing and explain transistor biasing. Ensure that the teaching materials, examples, and illustrations reflect diverse perspectives.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.3.3.LI.3	1.3.3.AS.3
	Describe the various transistor configurations and the use of an N-P-N transistor as a small signal amplifier. **Project-Based Learning:** Using group-based or mixed abilities, learners construct circuits for the Common Base Transistor configuration, the Common Emitter Transistor configuration and the Common collector Transistor configuration. Learners through presentations in the form of PowerPoint presentations and circuits describe the various characteristics and operations of the various configurations. Foster collaborations that broaden students' exposure to diverse physics-related career paths and role models.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning

Teaching and Learning Resources	• Videos • PhET interactive simulations	• Flash cards, Interactive virtual laboratory

Subject **PHYSICS**
Strand **4. ATOMIC AND NUCLEAR PHYSICS**
Sub-Strand **1. ATOMIC PHYSICS**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
1.4.1.LO.1		
Describe the of the various atomic models. i.e., J. J. Thompson's, Rutherford's and Bohr's.	**Communication and Collaboration:** Learners must collaboratively engage one another to develop the concept. **Critical thinking skills** of learners develop as they critique suggestions from their peers. **Digital literacy:** Learners learn to use ICT tools thereby developing their digital literacy skills.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Examine and dispel misconceptions/ myths about gender and disabilities as they relate to Physics. • Develop an understanding of gender equality in physics, recognising that all genders have the potential to excel in the field and contribute to scientific advancements. **SEL:** Learners, through their interactions with colleagues and the support provided by teachers as learn about the development of the various atomic models, help them to: • Embrace challenges and view mistakes as opportunities for learning and improvement. • Develop goal-setting and self-motivation strategies.

		National Core Values: • Resilience • Courage • Patience • Adaptability

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI			Assessment
1.4.1.CS.1	1. X.4.1.LI.1			1.4.1.AS.1
Demonstrate knowledge of J. J. Thompson's, Rutherford's, Bohr's models of the atom and recognise their limitations.	**Explain various atomic models and their limitations.** **Talk for Learning:** Recall learners' relevant previous knowledge of atomic models in chemistry and let learners discuss in mixed-ability groups of 3 to 5 and relate the models to setups or systems. Encourage reflection on the potential impact of biases on individuals' opportunities and aspirations, and foster a commitment to promoting equitable access and representation in the field.			**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1. X.4.1.LI.2			1.4.1.AS.2
	Calculate the energy of a photon during a transition. **Think Pair Share:** Let learners watch a video or a simulation of how electrons jump from one energy level to another. Guide learners to calculate the energy of a photon using E = hf Encourage the appreciation and valuing of the skills and abilities of individuals from diverse backgrounds, including gender, race, ethnicity, socioeconomic status, and disabilities.			Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Videos, • PhET interactive simulations,	• projectors, • audio-visuals,	• atomic activity model	

Subject **PHYSICS**
Strand **4. ATOMIC AND NUCLEAR PHYSICS**
Sub-Strand **2. NUCLEAR PHYSICS**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
1.4.2.LO.1		
Explain the factors that account for the stability of the nucleus.	**Communication and Collaboration:** Learners must collaboratively engage one another develop the concept. **Critical thinking** skills of learners developed as they critique suggestions from their peers. **Digital literacy:** Learners learn to use ICT tools thereby developing their digital literacy skills.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Actively work towards personal growth and overcoming these biases, promoting self-awareness and empathy. • Interrogate their stereotypes and biases about how both genders have contributed to the development of Physics and career and academic prospects. **SEL:** Learners through their interactions with colleagues and the support provided by teachers as learn about the nucleus of the atom, help them to: • Make constructive and respective choices about social interactions and personal behaviour. • Engage in self-reflection and support each other's learning.

		National Core Values: • Resilience • Courage • Patience • Adaptability

Content Standards	Learning Indicators and Pedagogical Exemplars with 21St Century and GESI	Assessment
1.4.2.CS.1	1.4.2.LI.1	1.4.2.AS.1
Demonstrate knowledge and understanding of the nucleus of an atom.	**Describe the structure of the nucleus of the atom.** **Talk for Learning:** Using simulations and multimedia, analyse the nucleus and let learners come out with factors that account for the stability of the nucleus. Investigate and discuss the historical and contemporary contributions of individuals, including women and individuals with disabilities, to the development of physics.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.4.2.LI.1.2	1.4.2.AS.1.2
	Explain radioactivity. **Talk for Learning:** Using simulations lets learners describe how radioactive substances undergo radioactive decay as well as the type of emissions given out during radioactive decay. Investigate and discuss the historical and contemporary contributions of individuals, including women and individuals with disabilities, to the development of physics.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	1.4.2.LI.1.2	1.4.2.AS.1.2
	Balance basic nuclear reactions. **Think pair share:** Guide learners to balance nuclear reactions. Foster an inclusive and supportive learning environment.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Videos • PhET interactive simulations • Projectors • Audio-visuals • Atomic activity model	

YEAR TWO

Subject **PHYSICS**
Strand **1. MECHANICS AND MATTER**
Sub-Strand **1. BASIC PHYSICS**

Learning Outcomes	21st Century Skills and Competencies	GESI[3], SEL[4] and Shared National Values
2.1.1.LO.1		
Use the concept of flotation and its related issues to identify substances that will float and give reasons why they will float.	**Creativity and problem-solving learners become creative by developing ways of overcoming challenges they encounter in carrying out the activity.** **Communication and collaboration:** Learners develop their communication skills as they share their experiences through talking to one another. They also learn to contribute to the common good. **Critical Thinking:** Learners will analyse the situation and come out with the relation between the weight of the body in air, weight in fluid and upthrust. **Creativity and problem-solving:** Learners become creative by stating Archimedes' principle and the principle of flotation from experiments.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Embrace diversity and practice inclusion as they relate to Physics. • Promote an inclusive learning environment that values and respects all voices. **SEL:** Learners obtain skills valuable for their overall personal and academic growth as they learn the concept of flotation by: • Adapting their problem-solving strategies to challenges. • Communicating their findings clearly and coherently. **National Core Values:** • Honesty • Teamwork

[3] Gender Equality and Social Inclusion
[4] Socio-Emotional Learning

		• Resilience • Integrity • Responsibility
2.1.1.LO.2		
Use Dimensional Analysis to check the validity and to derive equations.	**Critical thinking:** Learners establish the validity or other wise of an equation by simplifying the dimensions on both sides of the equation. **Creativity and problem-solving:** Learners will employ their knowledge in mathematics i.e., indices and simultaneous equations to establish the equations	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Embrace gender equity and equality as they relate to Physics. • Foster an inclusive classroom environment that celebrates the unique contributions of all. **SEL:** Learners obtain skills valuable for their overall personal and academic growth as they learn dimensional analysis by: • Developing strategies for goal setting. • Managing their emotions and behaviours effectively to achieve goals and aspirations. **National Core Values:** • Honesty • Resilience • Responsibility • Leadership
2.1.1.LO.3		
Use the concept of vectors to represent quantities	**Creativity and problem-solving:** Learners will employ their knowledge in mathematics i.e., Pythagoras's theorem and trigonometric ratios to determine components of vectors.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working

		with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Embrace diversity and practice inclusion as they relate to Physics. • Embrace gender equity and equality as they relate to Physics. **SEL:** Learners obtain skills valuable for their overall personal and academic growth as they learn the concepts of vectors by: • Collaborating effectively in team settings • Valuing diverse contributions and support each other's learning **National Core Values:** • Honesty • Fairness • Altruism • Resilience • Respect • Responsibility • Leadership

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
2.1.1.CS.1	2.1.1.LI.1	2.1.1.AS.1
Demonstrate knowledge and understanding of Flotation	**Explain density.** **Collaborative and Experiential learning:** Set up activity for the determination of density of solid, water and oil in mixed-ability groups of 3 to 5. • Ask learners to compare the densities of the various substances and record their observations. • From the definition of relative density let learners determine the relative densities of the various substances. Grouping must cater for vulnerable groups of learners. Opportunity for all to participate.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	2.1.1.LI.2	2.1.1.AS.2
	State Archimedes' principle. **Experiential learning and Collaborative learning:** In mixed-ability groups of 3 to 5 let learners through brainstorming come out with their experiences in the weights of objects in water and in air. • Let learners determine the upthrust experienced by the wood in water and in kerosene and go ahead to state Archimedes' principle. • Let learners determine the ratio of the upthrust in kerosene to that experienced in the water. Grouping must cater for vulnerable groups of learners. Opportunity for all to participate.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.1.1.LI.3	2.1.1.AS.3
	State principle of flotation. **Collaborative Learning:** Following from the activities in Archimedes' principle, let learners compare the weights of substances to their respective fluids they displace for both floating objects and non-floating objects and let learners draw conclusions from that. Grouping must cater for vulnerable groups of learners. Opportunity for all to participate.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning**

				Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Stone • Beaker • Measuring cylinder	• Electronic balance • Water	• Kerosene thread • Regular shaped piece of wood	• Irregular shaped object and • Salt spring balance

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
2.1.1.CS2	2.1.1.LI1	2.1.1.AS1
Demonstrate understanding of Dimensional Analysis and its relevance to working with equations.	**Check the validity of equations.** **Experiential Learning:** Let learners check the validity of equations by employing the dimensions of the quantities within the equation. Opportunity for all to participate. Grouping must cater for individuals with low levels of mathematical ability.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	2.1.1.LI.2	2.1.1.AS2
	Establish the relationship between quantities. **Talk for Learning:** Set up proportionalities between dependent variable and independent variables and use the dimensions of the quantities and simultaneous equations to establish the degree of dependency and subsequently establish the relationship between quantities. Opportunity for all to participate. Grouping must cater for individuals with low level of mathematical ability.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Chart comparing units • Chart converting from one unit to another • Calculator • Computer	

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI			Assessment
2.1.1.CS.3	2.1.1.LI.1			2.1.1.AS.1
Demonstrate knowledge and understanding of vectors	**Resolve vectors into their components.** **Collaborative learning:** In mixed-ability groups of 3 to 5, let learners employ their knowledge of trigonometric ratios and Pythagoras's theorem to determine the components of the vectors represented. Grouping must take into account gender parity/balance and low ability must be paired with high ability.			Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.1.1.LI.2			2.1.1.AS.2
	Determine the resultant of two vectors. **Collaborative learning:** In mixed-ability group of 5, give learners two vectors of the same quantity but different magnitudes and directions as components of a vector and let learners determine the magnitude and direction of the resultant vector.			Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Paper • Ruler	• Protractors • Calculator	• Computer	

Subject **PHYSICS**
Strand **1. MECHANICS AND MATTER**
Sub-Strand **2. MATTER**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
2.1.2.LO.1		
Use the concept of elasticity to predict the behaviour of materials under the influence of stress and strain.	**Communication and Collaboration:** Learners must collaboratively engage one another to develop the concept. **Critical thinking skills** of learners develop as they critique suggestions from their peers. **Digital literacy:** Learners learn to use ICT tools thereby developing their digital literacy skills.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Embrace diversity and practice inclusion as they relate to Physics. • Embrace gender equity and equality as they relate to Physics. **SEL:** Learners obtain skills valuable for their overall personal and academic growth as they learn the concepts of vectors by: • Managing their emotions and behaviours effectively to achieve goals and aspirations. • Engaging in self-reflection and support each other's learning. **National Core Values:** • Honesty • Altruism • Resilience • Respect

		• Responsibility • Leadership

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
2.1.2.CS.1	2.1.2.LI.1	2.1.2.AS.1
Demonstrate knowledge and understanding the behaviour of materials.	**Distinguish elastic deformation from plastic deformation.** **Collaborative learning:** • Let learners watch videos to see the various effect of forces on shape and size of substances. • Let learners brainstorm the effects of forces on the shape and size of substances observed from the video. • Let learners discuss and distinguish between elastic and plastic deformation as well as the types of stress that produce deformation. (Compressional, tensional and shear). Task given to learners must take into account mathematical abilities of individual learners.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.1.2.LI.2	2.1.2.AS.2
	State Hooke's law. **Project – based learning:** • Guide learners to perform an experiment to demonstrate the relationship between load and extension using the spring. • Guide learners to plot force-extension graph from a pair of points obtained their class activities. From the graph learners must state Hooke's law. • Let learners identify and explain the following from the graph plotted above: elastic limit, yield point, proportional limit. Task given to learners must take into account mathematical abilities of individual learners and explore contributions of vulnerable groups in the class.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	2.1.2.LI.3	2.1.2.AS.3
	Calculate the energy stored in an elastic material. **Project – based learning:** Let learners calculate the area under the load-extension graph and guide learners to deduce the energy store. Foster an inclusive and supportive learning environment.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning**

				Level 4 Extended critical thinking and reasoning
	2.1.2.LI.4			2.1.2.AS.4
	Calculate Young's modulus. **Collaborative learning:** Let learners find out the meaning of stress, strain and Young's modulus and use their findings to analyse and predict the behaviour of materials under stress and strain. Encourage the appreciation and valuing of the skills and abilities of individuals from diverse backgrounds, including gender, race, ethnicity, socioeconomic status, and disabilities.			Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Audio-visuals • Internet • Projectors	• YouTube • Interactive virtual laboratory • Retort stand	• Spring • Loading pan • Metre rule	• Pointer • Masses

Subject **PHYSICS**
Strand **1. MECHANICS AND MATTER**
Sub-Strand **3. KINEMATICS**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
2.1.3.LO.1		
Use projectiles to explain the performance of athletes in some field events,	**Creativity and problem-solving**: Learners will employ their knowledge in mathematics i.e., trigonometric ratios to determine components of the velocity which learners are going to use determine time taken to reach the maximum height, the maximum height and the range	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Embrace diversity and practice inclusion as they relate to Physics. • Embrace gender equity and equality as they relate to Physics. • Value and promote honesty and integrity. **SEL:** Learners obtain skills valuable for their overall personal and academic growth as they learn the concepts of projectiles by: • Developing goal-setting and self-motivation strategies. • Acquiring strategies to manage emotions, maintain focus and regulate behaviour during physics activities. **National Core Values:** • Honesty • Fairness

		• Resilience • Respect • Responsibility • Leadership • Flexibility
2.1.3.LO.2		
Use the concept of circular motion to explain how the earth is kept in its path.	**Critical thinking:** Learners will have to think and make meaning out of their findings. **Communication and collaboration:** Learners will have to talk to their peers and find out the findings from their peers. **Digital literacy:** Learners will learn how to use ICT tools and their skills in ICT usage will be improved.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Foster critical thinking and discussions around societal gender stereotypes, biases, and misconceptions related to physics • Engage in self-reflection, examining their biases and assumptions about gender and social inclusion in physics. **SEL:** Learners obtain skills valuable for their overall personal and academic growth as they learn the concepts of circular motion by: • Communicating their findings clearly and coherently. • Engaging in self-reflection and support each other's learning. **National Core Values:** • Creativity • Tolerance • Resilience

		• Respect • Responsibility • Leadership

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
2.1.3.CS.1	2.1.3.LI.1	2.1.3.AS.1
Demonstrate knowledge and understanding of projectile as two-dimensional motion.	**Identify some games and sports where projectiles are seen.** **Collaborative learning:** In mixed-ability groups of 3 to 5 let learners through brainstorming come out with examples of projectiles in some games and sports. • Let learners employ their knowledge in trigonometric ratios and Pythagoras's theorem to determine the components of the velocity of a projectile when the particle is fired at an angle to the horizontal. • Using think pair share let learners brainstorm and come out with factors that will affect the motion of the particle i.e., the horizontal and vertical dimensions of the motion. State any assumptions made. Investigate and discuss the historical and contemporary contributions of individuals, including women and individuals with disabilities, to the development of physics.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	2.1.3.LI.2	2.1.3.AS.2
	Determine the time taken by the projectile to reach the maximum height and the maximum height. **Collaborative Learning** • Using think pair share let learners use the equations of motion to determine the time taken to reach the maximum height, maximum height, and the time of flight. • Determine the horizontal distance making use of the horizontal component of the velocity. Explore contributions of vulnerable groups in the class.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.1.3.LI.3	2.1.3.AS.3
	Determine the range of a projectile. **Project – based learning:** Let learners determine the range as the horizontal distance travelled by the projectile. Recognise diverse talents and perspectives.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning**

			Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Audio-visuals	• Internet • projectors	• YouTube • Interactive virtual laboratory

Content Standards	Learning Indicators and Pedagogical Exemplars with 21St Century and GESI	Assessment
2.1.3.CS.2	2.1.3.LI.1	2.1.3.AS.1
Demonstrate knowledge and understanding of circular motion.	**Explain circular motion and give some examples of circular motion.** **Collaborative learning:** In mixed-ability groups, let learners watch videos on uniform circular motion and come out with their observations. Foster an inclusive and respectful classroom culture and address bias in teaching materials and examples.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	2.1.3.LI.2	2.1.3.AS.2
	Explain and calculate centripetal force. **Project-Based Learning:** • Learners through PowerPoint presentations, flash cards and schematics define and explain angular displacement, angular velocity and angular acceleration. • Let learners discuss the relationship between linear displacement and angular displacement, tangential velocity and angular velocity and tangential acceleration and angular acceleration. (Quantitative derivation of formula not needed). • Let learners discuss and state the expression for centripetal acceleration and relate it to centripetal force. (Qualitative treatment only). Encourage diverse perspectives and contributions.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.1.3.LI.3	2.1.3.AS.3
	Explain banking and skidding. **Talk for Learning:** • Let learners discuss applications of circular motion: i. banking of road and negotiating a bend ii. centrifuge iii. conical pendulum	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning

	• Guide learners to deduce the formular $\tan\theta = \frac{v^2}{rg}$ where v is the maximum allowed speed, r is the radius of the circle, g is the acceleration due to gravity and θ is the banking angle. Explore contributions of vulnerable groups in the class.		
	2.1.3.LI.4		2.1.3.AS.4
	Calculate maximum and minimum tension in a string. **Talk for Learning:** Discuss the relationship between the weight of a body tied to a string and whirled round in a vertical circle, the tension in the string and the centripetal force on the body Foster an inclusive and supportive learning environment.		Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Audio-visuals	• Internet • Projectors	• YouTube • Interactive virtual laboratory

Subject **PHYSICS**
Strand **1. MECHANICS AND MATTER**
Sub-Strand **4. DYNAMICS**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
2.1.4.LO.1		
Explain how friction affects our daily life.	**Communication and Collaboration:** Learners engage one another through discussion. **Critical thinking:** Learners will have to think through observations made by their peers and critique and also offer alterative views.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Facilitate opportunities to share their diverse perspectives, experiences, and ideas in physics discussions and activities. • Demonstrate respect for diverse perspectives and experiences in physics. **SEL:** Learners obtain skills valuable for their overall personal and academic growth as they learn the concepts of friction by: • Managing their emotions and behaviours effectively to achieve goals and aspirations. • Embracing challenges and viewing mistakes as opportunities for learning and improvement.

		National Core Values: • Honesty • Resilience • Respect • Responsibility • Adaptability

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI			Assessment
2.1.4.CS.1	2.1.4.LI.1			2.1.4.AS.1
Demonstrate knowledge and understanding of friction.	**Identify some effects and applications of friction.** **Collaborative learning:** • Let learners watch videos and brainstorm to bring out the meaning of friction and how it affects daily life. • Let learners distinguish between static and dynamic friction. • Let learners discuss the factors that affect friction. Recognise diverse talents and perspectives.			**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	2.1.4.LI.2			2.1.4.AS.2
	Determine the coefficient of friction. **Project – based learning:** Let learners perform simple experiment to determine the coefficient of friction using wooden blocks of different masses attached with hooks and a spring balance. Provide equitable access to physics resources, equipment, technology, and opportunities for hands-on experiments or projects, ensuring all learners have equal access to Learning resources and experiences.			Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Spring balance • Blocks of wood	• Electronic balance • Wooden/plastic/metallic boards for designing inclined planes and horizontal planes,	• Powder • oil/grease	

Subject **PHYSICS**
Strand **2. ENERGY**
Sub-Strand **1. HEAT**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
2.2.1.LO.1		
Design experiments with available resources in the laboratory to determine the specific heat capacities of liquids and solids and also to determine latent heat of fusion of a liquid.	**Critical thinking:** Learners will have to think and make meaning out of their findings. **Communication and collaboration:** Learners will have to talk to their peers and interrogate findings from peers. **Digital literacy:** Learners will learn how to use ICT tools and their skills in ICT usage will be improved. **Creativity and problem-solving**: Learners become creative by developing ways of overcoming challenges they encounter in carrying out the activity	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Engage in self-reflection, examining their biases and assumptions about gender and social inclusion in physics. • Encourage teamwork and cooperation among learners from diverse backgrounds, fostering the development of essential skills for working effectively with individuals from different genders, cultures, and identities. **SEL:** Learners obtain skills valuable for their overall personal and academic growth as they learn the concepts of heat by: • Developing goal-setting and self-motivation strategies. • Collaborating effectively in team settings.

		National Core Values: • Honesty • Resilience • Respect • Responsibility • Leadership

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
2.2.1.CS.1	2.2.1.LI.1	2.2.1.AS.1
Demonstrate knowledge and understanding of heat transfer from substances and recognise its importance in the choice of materials as good or bad conductors	**Explain specific heat capacity and classify substances into good and bad conductors of heat.** **Talk for learning:** Using the internet/reference books let learners research to find the meaning of the following terms: heat capacity, specific heat capacity, latent heat of fusion and latent heat of vaporisation. **Exemplars** • Let learners watch videos and record their observations or heat different substances for a given period of time and record the temperature rise. • Let learners brainstorm for them to come with reasons behind the differences in temperature rise although the substances were heated over the same time period. • Let learners identify the good conductors from bad conductors. Encourage self-awareness and personal growth by fostering an environment where learners feel comfortable sharing their reflections and experiences.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.2.1.LI.2	2.2.1.AS.2
	Calculate the specific heat capacities of substances: Following from the exemplars above, guide learners to define heat capacity and specific capacity and establish the relationship that exist between heat capacity and the specific heat capacity. Guide learners to use the method of mixtures, cooling curve method and electrical method to determine the specific heat capacities of liquids and solids. Encourage the appreciation and valuing of the skills and abilities of individuals from diverse backgrounds, including gender, race, ethnicity, socioeconomic status, and disabilities.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.2.1.LI.3	2.2.1.AS.3
	Describe how to determine the specific heat capacity of a solid using a liquid of a known specific heat capacity.	Level 1 Recall Level 2 Skills of conceptual understanding

	Experiential learning: Let learners perform experiment to determine the specific heat capacities of liquids and solids using the method of mixtures. Let learners deduce that the energy given out by immersing heater is equal to $V\,I\,t$ or I^2Rt. Explore contributions of vulnerable groups in the class.				**Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.2.1.LI.4				2.2.1.AS.4
	Explain latent heat of fusion and vaporisation and specific latent heat of fusion and vaporisation. **Enquiry:** • Let learners research on the following terminologies boiling, evaporation, melting, freezing as well as how the occur. • Guide learners to perform an experiment to determine the specific latent heat fusion of ice by the method of mixture. Foster an inclusive and supportive learning environment.				Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Audio-visuals • Internet	• Projectors • YouTube	• Virtual Lab Calorimeter apparatus • Benson burner/heater	• Thermometer • Masses (different metals)	

Subject **PHYSICS**
Strand **2. ENERGY**
Sub-Strand **2. WAVES**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
2.2.2.LO.1		
Deduce the wave equation to from the features of a periodic wave signal	**Communication and collaboration:** Learners will have to talk to their peers and interrogate findings from peers. **Digital literacy:** Learners will learn how to use ICT tools and their skills in ICT usage will be improved. **Creativity and problem-solving:** Learners become creative by navigating their way out to overcome challenges they encounter in carrying out the activity.	**GESI**: Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Actively work towards personal growth and overcoming these biases, promoting self-awareness and empathy. • Establish classroom norms and practices that foster respect, empathy, and inclusivity, ensuring all learners feel valued, supported, and free from discrimination or harassment based on gender, race, ethnicity, or ability. **SEL:** Learners obtain skills valuable for their overall personal and academic growth as they deduce the wave equation by: • Making constructive and respective choices about social interactions and personal behaviour • Demonstrating empathy towards their peers' perspectives and experiences.

		National Core Values: • Honesty • Resilience • Respect • Responsibility • Leadership
2.2.2.LO.2		
Using the property of reflection of sound and the phenomenon of resonance to give an account of how the speed of sound can be determined.	**Creativity and problem-solving:** Learners become creative by navigating their way out to overcome challenges they encounter in carrying out the activity.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Avoid perpetuating stereotypes, biases, or exclusionary language that may reinforce gender or social inequities. • Foster an inclusive classroom environment that celebrates the unique contributions of all. **SEL:** Learners obtain skills valuable for their overall personal and academic growth as they deduce the wave equation by: • Demonstrate adaptability and flexibility in problem-solving processes. • Promote intellectual humility and openness to alternative perspectives. **National Core Values:** • Honesty • Resilience • Respect • Responsibility

Content Standards	Learning Indicators and Pedagogical Exemplars with 21St Century Skills and GESI	Assessment
2.2.2.CS.1	2.2.2.LI.1	2.2.2.AS.1
Demonstrate knowledge and understanding of the wave equation	**Identify types of waves with its properties.** **Collaborative learning**: Using the internet/reference books let learners research to come out with the definition/explanation of the following terms; electromagnetic waves, mechanical waves, longitudinal waves, transverse waves, progressive waves, stationary waves, rarefactions, compressions, crest, trough, amplitude, wavelength, period and frequency. Use videos to demonstrate and discuss the following properties of wave; reflection, refraction, diffraction and interference of waves (superposition of waves). Recognise diverse talents and perspectives.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	2.2.2.LI.2	2.2.2.AS.2
	Classify waves under longitudinal, transvers, electromagnetic, mechanical, progressive and stationary. **Collaborative learning:** Show videos of wave motions generated by slinky, ropes and ripple tank and let learners identify some examples of waves and classify them in the various categories of waves. Recognise diverse talents and perspectives.	Level 1 Recall Level 2 Skills of conceptual understanding
	2.2.2.LI.3	2.2.2.AS.3
	Determine the amplitude, velocity, frequency, period, wavelength from a wave sinusoidal signal. **Collaborative learning:** Let learners employ the definition of speed/velocity to establish the relationship between the speed, wavelength and frequency or the period. Encourage self-awareness and personal growth by fostering an environment where learners feel comfortable sharing their reflections and experiences.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning

	2.2.2.LI.4			2.2.2.AS.4
	Given the amplitude, velocity, frequency, period, wavelength of a wave, deduce the wave equation. **Collaborative learning:** Let learners discuss the progressive wave equation and the terms associated with the wave equation. Encourage diverse perspectives and contributions.			Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Audio-visuals • Internet	• Projectors • YouTube	• Interactive virtual laboratory • Ripple tank	• Slinky • Bowl of water

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
2.2.2.CS.2	2.2.2.LI.1	2.2.2.AS.1
Demonstrate knowledge and understanding of sound waves.	**Explain the production, nature and transmission of sound.** **Collaborative learning**: Learners using some local musical instruments such as drums, percussions, flutes, horns and stringed instruments describe how sound is produced. Learners then discuss the longitudinal nature of sound. Instruments should be cut across the various ethnic groups. Opportunity for all to participate - be mindful of gender-biased groupings and should encourage peer teaching where applicable. Learners with some form of physical challenges should be assisted in the performance of the experiments. Foster collaborations that broaden students' exposure to diverse physics-related career paths and role models.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.2.2.LI.2	2.2.2.AS.2
	Classify sound into infrasonic, audio-sonic, and ultrasonic. **Collaborative learning:** Use a signal/frequency generator to help learners classify the frequencies of sound into infrasonic, audible and ultrasonic sound waves and their uses. Provide equitable access to resources and opportunities.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	2.2.2.LI.3	2.2.2.AS.3
	Explain how an echo comes about and apply the phenomenon in the determination of the depth of rivers. **Think pair share**: Using think pair share lets learners employ the concept of relating speed to distance and time to establish an equation for the speed of sound as far as a reflection of sound. Foster collaborations that broaden students' exposure to diverse physics-related career paths and role models.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning

	2.2.2.LI.4			2.2.2.AS.5
	Apply the concept of resonance in the determination of speed of sound in air. **Experiential learning:** Set up an experiment to determine to speed of sound in air using resonance (resonance tube/sonometer). Foster an inclusive and respectful classroom culture and address bias in teaching materials and examples.			**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Audio-visuals • Internet	• Projectors • YouTube • Interactive virtual laboratory	• Slinky • Sonometer • Guitar, piano	• Frequency/signal generator • Resonance tube set up

Subject **PHYSICS**
Strand **3. ELECTRIC FIELD, MAGNETIC FIELD AND ELECTRONICS**
Sub-Strand **1 ELECTROSTATICS**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
2.3.1.LO.1		
Use the concept of electric field to explain how charges interact	Critical thinking, creative thinking and communication	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Develop an understanding of gender equality in physics, recognising that all genders have the potential to excel in the field and contribute to scientific advancements. • Demonstrate respect for diverse perspectives and experiences in physics. **SEL:** Learners obtain skills valuable for their overall personal and academic growth as they learn the concepts of electric fields by: • Recognising resources and supports available through the family, school and the community. • Making responsible choices, seeking and offering help when needed.

		National Core Values: • Courage • Respect • Assertiveness
2.3.1.LO.2		
Explain and analyse the structure and working principles of capacitors and calculate capacitance.	Creative thinking, critical thinking, communication	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Promote an inclusive learning environment that values and respects all voices. • Actively work towards personal growth and overcoming these biases, promoting self-awareness and empathy. **SEL:** Learners obtain skills valuable for their overall personal and academic growth as they learn the concepts of capacitance by: • Acquiring strategies to manage emotions, maintain focus and regulate behaviour. • Communicating their findings clearly and coherently. **National Core Values:** • Courage • Respect • Assertiveness

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
2.3.1.CS.1	2.3.1.LI.1	2.3.1.AS.1
Demonstrate knowledge and understanding of electric fields	**Explain and show how an electric field is represented and their characteristics** **Project-Based learning**: Learners should develop a presentation on electric lines of force and their characteristics dwelling on their knowledge of magnetic field lines. Recognise diverse talents and perspectives.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	2.3.1.LI.2	2.3.1.AS.2
	State Coulomb's law of electrostatics and calculate electrostatic force acting on the charges. **Talk for Learning:** Describe Coulomb's law and explain the dependence of the force vectors on the signs of the charges Foster an inclusive and supportive learning environment.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.3.1.LI.3	2.3.1.AS.13
	Determine the Electric field strength/intensity at a point due to a point charge. **Talk for Learning:** Describe the electrostatic force as when charges are stationary and as the force exerted by two charged particles on each other. Foster an inclusive and supportive learning environment.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.3.1.LI.1.4	2.3.1.AS.1.4
	Define and calculate potential difference	**Level 1 Recall**

	Talk for Learning Building on what others say, learners explain electric potential and potential difference as well as their differences. Learners define and calculate potential difference and electric potential. Foster an inclusive and supportive learning environment		**Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Laptop/Computer • Projector • Internet	• Simulation lab software • Van de Graaff generator	• Flash cards • Science kit with connectors, resistors and capacitors

Content Standards	Learning Indicators and Pedagogical Exemplars with 21St Century and GESI	Assessment
2.3.1.CS.2	2.3.1.LI.1	2.3.1.AS.1
Demonstrate knowledge and understanding of the structure and operation of capacitors.	**Describe the structure and operation of capacitors.** **Talk for Learning:** Describe the structure of capacitors using flash cards and discuss the types of capacitors and applications Ensure that the teaching materials, examples, and illustrations reflect diverse perspectives.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.3.1.LI.2	2.3.1.AS.2
	Determine the effective capacitance of a number of capacitors arranged in i. series ii. Parallel. **Experiential Learning:** Using a laboratory set or science kit, explain series and parallel connections of capacitors and their relationship with respect to potential difference, total charges and capacitance. Provide equitable access to physics resources, equipment, technology, and opportunities for hands-on experiments or projects, ensuring all learners have equal access to Learning resources and experiences.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.3.1.LI.3	2.3.1.AS.3
	Determine the capacitance of a parallel plate capacitor. **Talk for Learning:** Use the factors that affect the capacitance that affect parallel plate capacitor i.e., the area of the plate, the permittivity of the dielectric material and the distance of separation between the plates. Explore contributions of vulnerable groups in the class.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.3.1.LI.4	2.3.1.AS.4
	Describe the behaviour of a capacitor in DC and AC circuits.	**Level 1 Recall** Level 2 Skills of conceptual understanding

	Project-Based Learning: Learners build a circuit to observe the behaviour of a capacitor in a DC circuit and then in an AC circuit. Learners record their observations and discuss with their colleagues in groups of mixed-ability. Investigate and discuss the historical and contemporary contributions of individuals, including women and individuals with disabilities, to the development of the capacitor.	**Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.3.1.LI.5	2.3.1.AS.5
	Calculate the energy stored in a capacitor. **Project-Based learning:** Learners in mixed groups present the mode of operation and principles of applications that depend on energy stored in a capacitor. Learners calculate the potential difference and capacitance using the relation Q=Cv Ensure that the teaching materials, examples, and illustrations reflect diverse perspectives.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Science experimental kit with capacitors and connectors	

Subject **PHYSICS**
Strand **3. ELECTRIC FIELD, MAGNETIC FIELD AND ELECTRONICS**
Sub-Strand **2. ELECTROMAGNETISM**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
2.3.2.LO.1		
Explain the how current is affected by the magnetic field using rules and calculations.	Personal and Social Skills, Communication, Creative and Critical Thinking	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Develop an understanding of gender equality in physics, recognising that all genders have the potential to excel in the field and contribute to scientific advancements. • Examine and challenge societal gender stereotypes and biases that may limit or discourage certain genders from pursuing physics. **SEL:** Learners obtain skills valuable for their overall personal and academic growth as they learn the concepts of magnetic fields by: • Valuing diverse contributions and support each other's learning. • Making constructive and respective choices about social interactions and personal behaviour.

		National Core Values: • Honesty • Resilience • Respect • Responsibility • Leadership

2.3.2.LO.2		
Demonstrate the repulsive and attractive forces between parallel current-carrying conductors in a magnetic field.	**Critical thinking:** Learners will have to analyse and evaluate to form their judgement. **Digital Literacy:** Learners will use IT and digital technology to find, evaluate, create and communicate information. **Communication and Collaboration:** Learners seamlessly exchange information and discuss topics as a team in order to achieve a common goal. **Problem solving:** Learners will identify the problem, analyse possible solutions, and implement the best possible solution. **Creativity and innovation:** Learners will be able to think of novel ideas and convert them into possible solutions.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Engage in self-reflection, examining their biases and assumptions about gender and social inclusion in physics. • Foster critical thinking and discussions around societal gender stereotypes, biases, and misconceptions related to physics. **SEL:** Learners obtain skills valuable for their overall personal and academic growth as they learn the concepts of magnetic fields by: • Develop goal-setting and self-motivation strategies • Embrace challenges and view mistakes as opportunities for learning and improvement. **National Core Values:** • Courage • Respect • Assertiveness

2.3.2.LO.3		
Demonstrate knowledge of the relationship between the magnetic field and the electric field.	Digital literacy, Creative and Critical Thinking, Communication	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Avoid perpetuating stereotypes, biases, or exclusionary language that may reinforce gender or social inequities. • Actively work towards personal growth and overcoming these biases, promoting self-awareness and empathy. **SEL:** Learners obtain skills valuable for their overall personal and academic growth as they learn the concepts of magnetic fields by: • Developing skills to persevere through challenges. • Adapting problem-solving strategies to challenges. **National Core Values:** • Honesty • Resilience • Responsibility

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
2.3.2.CS.1	2.3.2.LI.1	2.3.2.AS.1
Demonstrate knowledge and understanding in analysing the factors that affect the magnetic force on conductors carrying current in a uniform magnetic field.	**Describe the force exerted on a current-carrying conductor in a magnetic field.** **Experiential Learning**: Learners in groups of mixed abilities using simulation or laboratory set-up record their observations and describe the magnetic field around a current-carrying conductor: • straight conductor • parallel conductor with current in the same direction • parallel conductor flowing in opposite directions. • a narrow circular coil • a solenoid Guide learners to use Maxwell's right-hand corkscrew rule to determine the direction of the current in relation to withe field. Encourage diverse perspectives and contributions.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
	2.3.2.LI.2	2.3.2.AS.2
	Discuss the factors that affect the magnitude of the magnetic force on a current-carrying conductor in a magnetic field. **Talk for Learning:** Calculate the force on a current-carrying conductor in a magnetic field using $F = BIl \sin\theta$ Encourage the appreciation and valuing of the skills and abilities of individuals from diverse backgrounds, including gender, race, ethnicity, socioeconomic status, and disabilities.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
	2.3.2.LI.3	2.3.2.AS.3
	Discuss Fleming's left-hand rule. **Experiential Learning:** Explain Flemings Left-Hand Rule reflecting inclusivity through games and mnemonics. Ensure that the teaching materials, examples, and illustrations reflect diverse perspectives.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**

Teaching and Learning Resources	• Laptop/Computer • Projector • Internet	• Simulation lab software • Flash cards • Science kit set	• Magnets • Iron filings

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
2.3.2.CS.2	2.3.2.LI.1	2.3.2.AS.1
Demonstrate knowledge and understanding of the forces set up between parallel current-carrying conductors in a uniform magnetic field and applications.	**Explain the forces acting between parallel conductors carrying current in a magnetic field.** **Experiential Learning:** Demonstrate the repulsive and attractive forces between parallel current-carrying conductors in a magnetic field using simulation or laboratory set-up for learners in mixed-ability groupings. Ensure that the teaching materials, examples, and illustrations reflect diverse perspectives.	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
	2.3.2.LI.2	2.3.2.AS.2
	Explain the torque on rectangular current carrying coil in a magnetic field. **Project-Based Learning:** Learners in pairs construct a basic electric motor and discuss its operation. Provide equitable access to resources and opportunities.	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
	2.3.2.LI.3	2.3.2.AS.3
	Describe and analyse the structure and working principle of the motor and moving coil galvanometer. **Project-Based Learning**: Learners in pairs construct a basic electric motor and discuss its operation. Draw and discuss the principle of a moving coil galvanometer. Discuss the factors that affect the current sensitivity of the galvanometer. Provide equitable access to resources and opportunities.	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**

	2.3.2.LI.4		2.3.2.AS.4
	Describe the electromagnetic switches and applications. **Experiential Learning:** Learner draws and explain the construction and working principles of electromagnetic switches and their applications. Recognise diverse talents and perspectives.		**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Audio visuals	• Internet • Projectors	• YouTube • Interactive virtual laboratory

Content Standards	Learning Indicators and Pedagogical Exemplars with 21St Century and GESI	Assessment
2.3.2.CS.3	2.3.2.LI.1	2.3.2.AS.1
Demonstrate knowledge and understanding of the force exerted on a charged particle moving in electric and magnetic fields, and their applications	**Calculate force on a charged particle in a magnetic field.** **Experiential Learning:** Using video simulations explain the main factors that affect charged particles moving in the magnetic field i.e., direction of the field, direction of the particle and charge of the particle. **Experiential Learning:** Using video simulations explain the main factors that affect charged particles moving in a magnetic field as well as a crossed field charge of the particle. $F = Bvq \sin \phi$ $E = Bv$ Foster an inclusive and supportive learning environment.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.3.2.LI.2	2.3.2.AS.2
	Explain force on a moving charged particle in an electric field. **Experiential Learning:** Using video simulations explain the main factors that affect charged particles moving in the magnetic field i.e., the direction of the field, the direction of the particle and the charge of the particle.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.3.2.LI.3	2.3.2.AS.3
	Describe force on a moving charged particle in a crossed field (Lorentz force). **Experiential Learning:** Using video simulations describe how the electric and magnetic fields affect the acceleration and direction of the charge respectively. Learners describe a crossed field. Recognise diverse talents and perspectives.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning

Teaching and Learning Resources	• Laptop/ Computer • Projector	• Internet • Simulation lab software	• Science kit set

Subject **PHYSICS**
Strand **3. ELECTRIC FIELD, MAGNETIC FIELD AND ELECTRONICS**
Sub-Strand **3. DIGITAL ELECTRONICS**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
2.3.3.LO.1		
Distinguishing between digital and analogue signals and how digital systems work.	Collaboration and Teamwork, Creative and Critical Thinking, Communication	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Develop an understanding of gender equality in physics, recognising that all genders have the potential to excel in the field and contribute to scientific advancements. • Actively work towards personal growth and overcoming these biases, promoting self-awareness and empathy **SEL:** Learners obtain skills valuable for their overall personal and academic growth as they learn the concepts of analogue and digital signals by: • Establishing and maintaining healthy relationships • Negotiating conflicts constructively and resisting inappropriate social pressure.

		National Core Values: • Courage • Respect • Assertiveness
2.3.3.LO.2		
Distinguish between the working operations of analogue and digital systems as well as design and build a decision-making circuit.	Collaboration and Teamwork, Creative and Critical Thinking, Communication	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Embrace diversity and practice inclusion as they relate to Physics. • Promote an inclusive and diverse representation of physicists. **SEL:** Learners obtain skills valuable for their overall personal and academic growth as they learn the concepts of analogue and digital systems by: • Demonstrating adaptability and flexibility in problem-solving processes. • Seeking the well-being of self and others. **National Core Values:** • Courage • Respect • Assertiveness

2.3.3.LO.3		
Describe integrated circuits and design and build simple integrated circuits.	Collaboration and Teamwork, Creative and Critical Thinking, Communication	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Facilitate opportunities to share their diverse perspectives, experiences, and ideas in physics discussions and activities. • Develop the skills and confidence to advocate for gender equality and social inclusion in the physics community and beyond, promoting awareness, dialogue, and action to address systemic barriers and biases. **SEL:** Learners obtain skills valuable for their overall personal and academic growth as they learn the concepts of integrated circuits by: • Making responsible choices, seeking and offering help when needed. • Communicating their findings clearly and coherently. **National Core Values:** • Courage • Respect • Assertiveness

Content Standards	Learning Indicators and Pedagogical Exemplars with 21St Century and GESI	Assessment
2.3.3.CS.1	2.3.3.LI.1	2.3.3.AS.1
Demonstrate and understanding of the basics of Digital Electronics.	**Describe analogue and digital signals**. **Experiential Learning and Talk for Learning:** Describe and explain analogue and digital graphical displays using an oscilloscope and their advantages and disadvantages. Explain the need the convert between analogue and digital systems. Explore contributions of vulnerable groups in the class.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.3.3.LI.2	2.3.3.AS.2
	Distinguish between pull up and pull-down resistors. **Experiential Learning:** Using videos or an experimental set up, differentiate between pull up and pull-down resistors and describe their applications. Ensure that the teaching materials, examples, and illustrations reflect diverse perspectives.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.3.3.LI.3	2.3.3.AS.3
	Describe and use the 7-segment display module. **Talk for Learning and Project-Based Learning** Describe how the 7-segment display module works using the truth table. Learners in groups, develop a code using the truth table to write their class names.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• ICT • Use of simulation laboratories • Use of science sets • Use of oscilloscope • Basic soldering	

Content Standards	Learning Indicators and Pedagogical Exemplars with 21St Century and GESI	Assessment
2.3.3.CS.2	2.3.3.LI.1	2.3.3.AS.1
Demonstrate the understanding of logic gates and describe their output in a digital system.	**Distinguish between analogue and digital signals and describe their functions.** **Problem Based Learning:** Learners describe through differentiation, draw and analyse analogue and digital signals. Encourage the appreciation and valuing of the skills and abilities of individuals from diverse backgrounds, including gender, race, ethnicity, socioeconomic status, and disabilities.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	2.3.3.LI.2	2.3.3.AS.2
	Describe the characteristics of basic logic and universal gates. **Experiential Learning**: Utilising previous knowledge of truth tables, learners describe truth tables and show the output of digital circuits of input combinations. **Talk for Learning and Project-Based Learning**: Explain logic gates, draw their symbols and construct truth tables for NOT, AND, OR, NAND and NOR gates. Learners in pairs construct codes to apply in some applications in their community. Encourage the appreciation and valuing of the skills and abilities of individuals from diverse backgrounds, including gender, race, ethnicity, socioeconomic status, and disabilities.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
	2.3.3.LI.3	2.3.3.AS.3
	Describe and explain sum of product in Boolean notation. **Talk for learning:** Use Boolean notation to write expressions for NOT, AND, OR, NAND and NOR gates **Experiential learning:** Learners in pairs, convert truth tables (up to three inputs) into a sum of product Boolean expression. Explore contributions of vulnerable groups in the class.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**

	2.3.3.LI.4		2.3.3.AS.4
	Describe combinational logic applications and microcontroller. **Talk for Learning:** Describe and explain the function of a given combination logic circuit. **Project-Based Learning:** Learners in groups of mixed abilities describe the features and characteristics of an Arduino and apply in solving some basic challenges in their community. Foster respect and inclusion in physics, creating an inclusive and welcoming classroom environment that values the contributions of individuals from all backgrounds and genders.		**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Laptop/Computer • Projector	• Internet • Simulation lab software	• Science kit set

Content Standards	Learning Indicators and Pedagogical Exemplars with 21St Century and GESI			Assessment
2.3.3.CS.3	2.3.3.LI.1			2.3.3.AS.1
Demonstrate knowledge and understanding of simple integrated circuits and be able to Identify and construct them.	**Describe simple integrated circuits.** **Experiential Learning:** Identify simple integrated circuits using charts. Recognise diverse talents and perspectives.			Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.3.3.LI.2			2.3.3.AS.2
	Design and describe the fabrication of a simple integrated circuit. **Experiential Learning:** Describe the process of design and fabrication of integrated circuits. **Project-Based Learning:** Group students based on mixed abilities to design and fabricate a simple IC. Provide learners with exposure to diverse perspectives and opportunities to challenge stereotypes and promote inclusive practices in physics.			Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• laptop/Computer • Projector	• Internet • Simulation lab software	• Science kit set	

Subject **PHYSICS**
Strand **4. ATOMIC AND NUCLEAR PHYSICS**
Sub-Strand **1. ATOMIC PHYSICS**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
2.4.1.LO.1		
Appreciate its application in the operation of automatic doors and security setups. Explain photoelectric effect and appreciate its application in the operation of automatic doors and security setups.	**Communication and Collaboration:** Learners must collaboratively engage one another develop the concept. **Critical thinking skills** of learners are developed as they critique suggestions from their peers. **Digital literacy**: Learners learn to use ICT tools.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Establish classroom norms and practices that foster respect, empathy, and inclusivity, ensuring all learners feel valued, supported, and free from discrimination or harassment based on gender, race, ethnicity, or ability. • Promote gender equality and social inclusion in physics, allowing them to learn from diverse perspectives and aspire to various physics-related careers and opportunities. **SEL:** Learners obtain skills valuable for their overall personal and academic growth as they learn the concepts of integrated circuits by: • Demonstrate the ability to collaborate with peers effectively.

		• Develop skills to persevere through challenges. • Adapt problem-solving strategies to challenges. **National Core Values:** • Honesty • Resilience • Respect • Responsibility • Leadership

Content Standards	Learning Indicators and Pedagogical Exemplars with 21St Century and GESI	Assessment
2.4.1.CS.1	2.4.1.LI.1	2.4.1.AS.1
Demonstrate knowledge and understanding of photoelectric effect.	**Explain photoelectric effect and wave-particle duality.** **Experiential Learning:** Let learners watch videos on photoelectric effect and its applications. Encourage diverse perspectives and contributions.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	2.4.1.LI.1.2	2.4.1.AS.1.2
	State the laws of photoelectric effect **Experiential Learning:** Let learners watch videos on photoelectric effect and its applications. Encourage diverse perspectives and contributions.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.4.1.LI.1.3	2.4.1.AS.1.3
	Identify areas of application of photoelectric effect and how they are applied. **Experiential Learning:** Let learners watch videos on photoelectric effect and its applications. Encourage self-awareness and personal growth by fostering an environment where learners feel comfortable sharing their reflections and experiences.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Videos • PhET interactive simulations	• Projectors • audio-visuals

Subject **PHYSICS**
Strand **4. ATOMIC AND NUCLEAR PHYSICS**
Sub-Strand **2. NUCLEAR PHYSICS**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
2.4.2.LO.1		
Recognise the amount of energy an atom can produce when there is a change in its mass.	**Digital literacy:** learners learn to use ICT tools thereby developing their digital literacy skills. **Communication and Collaboration:** learners must collaboratively engage one another to develop the concept. Critical thinking skills of learners develop as they critique suggestions from their peers.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Embrace diversity and practice inclusion as they relate to Physics. • Embrace gender equity and equality as they relate to Physics. **SEL:** Learners obtain skills valuable for their overall personal and academic growth as they learn the concepts of an atom: • Collaborating effectively in team settings. • Promoting intellectual humility and openness to alternative perspectives. **National Core Values:** • Courage • Respect • Assertiveness

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
2.4.2.CS.1	2.4.2.LI.1	2.4.2.AS.1
Demonstrate knowledge and understanding of the atom as an agent for energy production	**State the radioactive decay law** **Experiential Learning:** Guide learners to discuss and state the radioactive decay law. Engage learners in discussions and activities that examine prevalent myths or misconceptions surrounding gender and disabilities in the context of physics, encouraging critical thinking and dispelling these misconceptions through evidence-based exploration.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.4.2.LI.2	2.4.2.AS.2
	Calculate the half-life of a radioactive sample. **Experiential Learning** • Let learners discuss Activity, half-life, and decay constant. • Assist learners in establishing the mathematical relation between half-life and decay constant. Foster an inclusive and supportive learning environment.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	2.4.2.LI.3	2.4.2.AS.3
	Calculate the age of bone specimen **Experiential Learning:** Using simulations /multimedia guide learners to identify areas of application of radioactivity. Investigate and discuss the historical and contemporary contributions of individuals, including women and individuals with disabilities, to the development of the concept of radioactivity.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Videos • PhET interactive simulations	• Projectors • Audio-visuals

YEAR THREE

Subject **PHYSICS**
Strand **1. MECHANICS AND MATTER**
Sub-Strand **1. BASIC PHYSICS**

Learning Outcomes	21st Century Skills and Competencies	GESI[5], SEL[6] and Shared National Values
3.1.1.LO.1		
Use the concept of moments to determine the mass of a body	**Creativity and problem-solving:** Learners become creative by developing ways of overcoming challenges they encounter in carrying out the activity. **Communication and Collaboration:** Learners must collaboratively engage one another to develop the concept.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Sensitive to the inter-relatedness of the various aspects of life. • Ensuring mixed-ability groupings will allow learners interact and appreciate each other's strengths and weaknesses and identify individual skills and interest. **SEL:** Learning the concepts of moments, learners cultivate essential skills for personal growth as they: • Develop strategies for goal setting. • Engage in self-reflection and support each other's learning. **National Core Values:** • Assertiveness

[5] Gender Equality and Social Inclusion
[6] Socio-Emotional Learning

		• Ingenuity • Patience • Adaptability SI
3.1.1.LO.2		
Explain the concept of gravitation.	**Critical thinking:** Learners will have to analyse and evaluate to form their judgement. **Digital Literacy:** Learners will use IT and digital technology to find, evaluate, create and communicate information.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Provide opportunities to highlight the contributions and achievements of historically underrepresented groups (including women, racial and ethnic minorities, and individuals with disabilities) in physics. • Ensuring mixed-ability groupings will allow learners interact and appreciate each other's strengths and weaknesses and identify individual skills and interest. **SEL:** Learning the concepts of gravitation, learners cultivate essential skills for personal growth as they: • Demonstrate adaptability and flexibility in problem-solving processes. • Recognise resources and supports available through the family, school and the community. **National Core Values:** • Assertiveness

		• Ingenuity • Patience • Adaptability • Resilience
3.1.1.LO.3		
Use the knowledge in space science to explain the world beyond the earth.	**Critical thinking**: Learners will have to analyse and evaluate to form their judgement. **Digital Literacy**: Learners will use IT and digital technology to find, evaluate, create and communicate information. **Communication and Collaboration:** Learners seamlessly exchange information and discuss topics as a team in order to achieve a common goal. **Problem solving:** Learners will identify the problem, analyse possible solutions, and implement the best possible solution. **Creativity and innovation:** Learners will be able to think of novel ideas and convert them into possible solutions.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Engage in self-reflection, examining their biases and assumptions about gender and social inclusion in physics. • Demonstrate respect for diverse perspectives and experiences in physics. **SEL:** Learning the concepts of space science, learners cultivate essential skills for personal growth as they: • Embrace challenges and view mistakes as opportunities for learning and improvement. • Collaborate effectively in team settings. **National Core Values:** • Assertiveness • Ingenuity • Adaptability • Resilience • Curiosity

		• Respect • Unity

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
3.1.1.CS.1	3.1.1.LI.1	3.1.1.AS.1
Demonstrate knowledge and understanding of moments	**Explain moments.** **Brainstorming:** Let learners identify situations where turning effect of forces is evident in daily life for them to come out with explanation of moments. Recognise diverse talents and perspectives.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	3.1.1.LI.2	3.1.1.AS.3
	State the principle of moments. **Experiential learning and Collaborative learning:** Set up experiment for students in groups of mixed abilities to establish the principle of moments. Foster an inclusive and supportive learning environment.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	3.1.1.LI.3	3.1.1.AS.3
	State the conditions necessary for a body to be in equilibrium. **Experiential learning and Collaborative learning:** From the experiment, let learners brainstorm and identify conditions that will cause disequilibrium of the set up used in verifying the principle of moments. Foster an inclusive and supportive learning environment.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	3.1.1.LI.4	3.1.1.AS.4
	Calculate the reactions provided by supports. **Enquiry learning** From the experiment, let learners brainstorm and come out with the reaction provided by knife edge.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning**

	Provide equitable access to resources and opportunities.		Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Metre rule, • Standard masses,	• Knife edge • Unknown masses. E.g., Stone, erasers, reference books, internet.	

Content Standards	Learning Indicators and Pedagogical Exemplars with 21St Century and GESI	Assessment
3.1.1.CS.2	3.1.1.LI.1	3.1.1.AS.1
Demonstrate knowledge and understanding of gravitation.	**State Newton's law of universal gravitation.** **Enquiry learning:** Learners develop Newton's law of universal gravitation using their previous knowledge from Coulomb's law. Explore contributions of vulnerable groups in the class.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	3.1.1.LI.2	3.1.1.AS.2
	Deduce the relationship between acceleration due to gravity g and universal gravitational constant G. **Enquiry learning:** Learners develop the relationship between acceleration due to gravity g and the universal gravitational constant G and the radius of the earth R Guide students to interrogate their misconceptions and biases about the gravitation.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	3.1.1.LI.3	3.1.1.AS.3
	Deduce the period of rotation of a satellite moving in a circular orbit. **Enquiry learning:** Learners using previous knowledge in circular motion, deduce the period of a satellite moving around another object for example the moon around the earth. Learners describe the types of satellites. Foster an inclusive and supportive learning environment.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	3.1.1.LI.4	3.1.1.AS.4
	Explain weightlessness **Experiential Learning:** Learners watch a documentary or movie on the effect of gravity on the life activities in space. Learners understand that living in space requires collaboration and respect	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning

	of other cultures. Learners also understand that both genders live in harmony and undergo same training for space expeditions. Examine biases in space science-related career and academic prospects.		**Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Audio-visuals • PhET interactive simulations • Internet, projectors	• Laptop/computer • YouTube	• Field visit • Reference books

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
3.1.1.CS.3	3.1.1.LI.1	3.1.1.AS.1
Demonstrate knowledge and understanding of the basics of space science.	**Explain the universe and its composition as applied to astronomy and cosmology**. **Experiential learning:** • Learners watch a documentary or movie that identifies and describes key technological advances in space exploration and research. • Investigate and discuss the historical and contemporary contributions of individuals, including women and individuals with disabilities, to the development of space science.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	3.1.1.LI.2	3.1.1.AS.2
	Explain how our indigenous culture benefits from and applies to astronomy and cosmology. **Experiential Learning:** Learners go on a field visit to the planetarium, astronomical observatory or an elder of the community, chief's palace, religious leaders (traditional priest, community elder, priest, pastor, imam or any person of in-depth knowledge) to understand how their culture is influenced by astronomy and cosmology. Encourage reflection on the potential impact of biases on individuals' opportunities and aspirations, and foster a commitment to promoting equitable access and representation in the field of space science.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	3.1.1.LI.3	3.1.1.AS.3
	Explain the formation of the sun, planets and stars. **Enquiry learning:** Using the internet/reference books let learners research to come out with information on the formation of the sun, planets and stars. Challenge stereotypes and misconceptions about gender and disabilities in the study of space science.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning

	3.1.1.LI.4			3.1.1.AS.4
	Describe galaxies and their various types - elliptical, spiral, irregular, quasars, blazers, Lenticular, active, seyfert. **Enquiry Learning:** Using videos and pictures, describe constellations and learners in groups link them to local activities in their culture and how they are used. Describe the types of nebulas - super nova and planetary nebulas Encourage the appreciation and valuing of the skills and abilities of individuals from diverse backgrounds, including gender, race, ethnicity, socioeconomic status, and disabilities.			**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	3.1.1.LI.5			3.1.1.AS.5
	Explain how extra solar objects such as Comets, Asteroids and Constellations affect our culture and society. **Enquiry Learning:** Using videos and pictures, describe and distinguish between comets, asteroids, meteors, meteorites Learners watch videos of how comets and asteroids move and their characteristics. Ensure that the teaching materials, examples, and illustrations reflect diverse perspectives.			**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Audio-visuals • PhET interactive simulations • Internet	• Projectors • laptop/computer • YouTube	• Field visit • Reference book	

Subject **PHYSICS**
Strand **1. MECHANICS AND MATTER**
Sub-Strand **2. KINEMATICS**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
3.1.2.LO.1		
Use the concept of simple harmonic motion to determine acceleration due to gravity.	**Communication and Collaboration:** Learners will have to talk to their peers and interrogate findings from peers. **Digital literacy:** Learners will learn how to use ICT tools and their skills in ICT usage will be improved. **Creativity and problem-solving**: Learners become creative by navigating their way out to overcome challenges they encounter in carrying out the activity.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Actively work towards personal growth and overcoming these biases, promoting self-awareness and empathy. • Examine and challenge societal gender stereotypes and biases that may limit or discourage certain genders from pursuing physics. **SEL:** Learning the concept of simple harmonic motion, learners cultivate essential skills for personal growth as they: • Communicate their findings clearly and coherently. • Develop goal-setting and self-motivation strategies. **National Core Values:** • Assertiveness • Integrity

		• Resilience • Curiosity • Respect • Unity

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
3.1.2.CS.1	3.1.2.LI.1	3.1.2.AS.1
Demonstrate knowledge and understanding of simple harmonic motion.	**Explain simple harmonic motion and give some examples of such type of motion.** **Collaborative and experiential learning:** Using videos or laboratory set up of oscillatory motions, learners come out with the definition of SHM and examples of SHM. Foster an inclusive and respectful classroom culture and address bias in teaching materials and examples.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	3.1.2.LI.2	3.1.2.AS.2
	Determine the velocity, acceleration and kinetic energy of a body performing SHM. **Enquiry learning:** Learners watch a video of the motion of a piston and through research come out with equations for the displacement, velocity and acceleration of a body performing SHM. Recognise diverse talents and perspectives.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	3.1.2.LI.3	3.1.2.AS.3
	Explain the variation of potential and kinetic energy of body performing SHM. **Experiential learning:** Set up experiments for learners to determine the acceleration due gravity using simple pendulum and the helical spring. Provide equitable access to resources and opportunities.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	3.1.2.LI.4	3.1.2.AS.4
	Determine the energy stored in a system performing SHM. **Experiential Learning:** Let learners discuss the energy of a body performing simple harmonic motion for simple pendulum. For the helical spring apply your knowledge from area under the load-extension graph.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning**

	Encourage self-awareness and personal growth by fostering an environment where learners feel comfortable sharing their reflections and experiences.			Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Audio-visuals • Internet	• Projectors • YouTube • Interactive virtual laboratory	• Retort stand • Spring with pointer • Meter rule	• String • Masses

Subject **PHYSICS**
Strand **1. MECHANICS AND MATTER**
Sub-Strand **3. DYNAMICS**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
3.1.3.LO.1		
Use the concept of momentum change to verify of Newton's second and third laws of motion.	**Digital literacy:** Learners will learn how to use ICT tools and their skills in ICT usage will be improved. **Communication and collaboration:** Learners will have to talk to their peers and interrogate findings from one another.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Provide opportunities to highlight the contributions and achievements of historically underrepresented groups (including women, racial and ethnic minorities, and individuals with disabilities) in physics. • Engage in self-reflection, examining their biases and assumptions about gender and social inclusion in physics. **SEL:** Learning the concept of momentum, learners cultivate essential skills for personal growth as they: • Value diverse contributions and support each other's learning • Develop goal-setting and self-motivation strategies. **National Core Values:**

		• Assertiveness • Resilience • Curiosity • Respect • Unity

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
3.1.3.C.S.3.1	3.1.3.LI.1.1	3.1.3.AS.1.1
Demonstrate knowledge and understanding of collisions	**Distinguish between elastic and inelastic collision.** **Collaborative learning:** Let learners watch a video of bodies involved in collisions for learners to come out with the difference between elastic and inelastic collisions and make deductions. Foster an inclusive and supportive learning environment.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	3.1.3.LI.1.2	3.1.3.AS.1.2
	Use momentum change to establish impulse and hence deduce Newton's second law of motion. **Enquiry learning:** • Let learners use the principle of conservation of momentum to establish an equation to enable them to determine the common velocity for situations of inelastic collisions. • Let learners establish equations to enable them to determine the velocity for situations of elastic collisions. i.e., learners must employ conservation of momentum and kinetic energy. Provide equitable access to resources and opportunities.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	3.1.3.LI.1.3	3.1.3.AS.1.3
	Verify Newton's third law of motion from momentum change. **Enquiry learning:** Let learners verify Newton's third law of motion by comparing the momentum change of one body to another body following from elastic collision. Recognise diverse talents and perspectives.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Audio-visuals • Internet • Projectors • YouTube • Interactive virtual laboratory	

Subject **PHYSICS**
Strand **2. ENERGY**
Sub-Strand **1. HEAT**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
3.2.1.LO.1		
Explain how expansion occurs in solids, liquids and gases.	**Digital literacy:** Learners will learn how to use ICT tools and their skills in ICT usage will be improved. **Communication and collaboration:** Learners will have to talk to their peers and interrogate findings from one another.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Avoid perpetuating stereotypes, biases, or exclusionary language that may reinforce gender or social inequities. • Develop the skills and confidence to advocate for gender equality and social inclusion in the physics community and beyond, promoting awareness, dialogue, and action to address systemic barriers and biases. **SEL:** Learning the concept of expansion in solids, liquids and gases, learners cultivate essential skills for personal growth as they: • Collaborate effectively in team settings. • Learn to communicate with diverse individuals and groups. **National Core Values:** • Assertiveness

		• Resilience • Curiosity • Respect • Unity

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI			Assessment
3.2.1.CS.1	3.2.1.LI.1			3.2.1.AS.1
Demonstrate knowledge and understanding of heat as agent of expansion of states of matter.	**Explain linear, area and volume expansivities.** **Think pair share** • Show videos of the effect of heat on solid, liquid and gas. • Let learners discuss thermal expansion in solids, liquids and gases.			Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	3.2.1.LI.2			3.2.1.AS.2
	Calculate the linear, area, and volume expansivities of metals. **Think pair share:** • Let learners discuss the importance of expansion and how a bimetallic strip can be used as an electric circuit breaker. • Let learners determine the linear, superficial and cubic expansivity of solids. Explore contributions of vulnerable groups in the class.			**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	3.2.1.LI.3			3.2.1.AS.3
	Group metals in increasing order of expansion property using their linear expansivities. **Think pair share:** Learners use data on linear expansivity of various metals and group them according to their increasing order of expansion. Foster collaborations that broaden students' exposure to diverse physics-related career paths and role models.			**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Audio-visuals	• Internet • Projectors	• YouTube • Interactive virtual laboratory	

Subject **PHYSICS**
Strand **2. ENERGY**
Sub-Strand **2. WAVE**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
3.2.2.LO.1		
Use the working principles of lenses to explain the operation of some optical instruments.	**Critical thinking**: Learners will have to think and make meaning out of their findings. **Communication and collaboration**: Learners will have to talk to their peers and find out the findings from their peers. **Digital literacy:** Learners will learn how to use ICT tools and their skills in ICT usage will be improved. **Critical thinking:** Learners will have to think to identify the rays that are refracted for image formation.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Engage in self-reflection, examining their biases and assumptions about gender and social inclusion in physics. • Promote gender equality and social inclusion in physics, allowing them to learn from diverse perspectives and aspire to various physics-related careers and opportunities. **SEL:** Learning the working principles of lenses, learners cultivate essential skills for personal growth as they: • Demonstrate empathy towards their peers' perspectives and experiences. • Collaborate effectively in team settings. **National Core Values:** • Assertiveness

		• Resilience • Curiosity • Respect • Unity
3.2.2.LO.2		
Explain the production and working principles of lasers.	**Critical thinking:** Learners will have to think and make meaning out of their findings **Communication and collaboration:** Learners will have to talk to their peers and find out the findings from their peers. **Digital literacy:** Learners will learn how to use ICT tools and their skills in ICT usage will be improved. **Critical thinking**: Learners will have to think to identify some applications of lasers.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Foster critical thinking and discussions around societal gender stereotypes, biases, and misconceptions related to physics • Avoid perpetuating stereotypes, biases, or exclusionary language that may reinforce gender or social inequities. **SEL:** Learning the production and working principles of lasers, learners cultivate essential skills for personal growth as they: • Establishing and maintaining healthy relationships. • Negotiating conflicts constructively and resisting inappropriate social pressure. **National Core Values:** • Assertiveness • Resilience • Curiosity • Respect • Unity

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
3.2.2.CS.1	3.2.2.LI.1	3.2.2.AS.1
Demonstrate knowledge and understanding of lenses	**Identify the types and features of lenses.** **Collaborative learning:** Using the internet/reference books, let learners research to find the meaning of the following terms concave lens, convex lens, pole, principal focus, principal/central axis, focal length, and optical centre before watching a video. Encourage diverse perspectives and contributions.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	3.2.2.LI.2	3.2.2.AS.2
	Describe how images are formed by lenses. **Collaborative learning:** Let learners to watch a video/simulation to see how lenses form images and identify and note the rays that are involved in the image formation process after watching the video. Engage with inclusive resources and role models in physics.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	3.2.2.LI.3	3.2.2.AS.3
	Calculate the image distance and the magnification using the lens formula. **Experiential learning:** Let learners use the lens formula to determine image position, magnification and characteristics i.e., Real is positive and cartesian convention. Recognise diverse talents and perspectives.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Audio-visuals • Internet • Projectors • YouTube • Interactive virtual laboratory • Reference books	

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
3.2.2.CS.2	3.2.2.LI.1	3.2.2.AS.1
Demonstrate knowledge and understanding of lasers	**Identify features of laser configuration.** **Experiential learning:** Using the internet/reference books let learners research to find the meaning of the following terms: pumping, population inversion, active medium, metastable state and stimulated emission. Explore contributions of vulnerable groups in the class.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	3.2.2.LI.1.2	3.2.2.AS.1.2
	Describe the production of a laser beam. **Experiential learning:** Let learners to watch a video/simulation to see how lasers are produced.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	3.2.2.LI.1.3	3.2.2.AS.1.3
	Identify the properties of lasers. **Collaborative learning:** Put learners in mixed-ability groups of 5 and let each group do a presentation on lasers i.e., monochromaticity, brightness, coherence and collimation.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Audio-visuals • Internet • projectors • YouTube • Interactive virtual laboratory	

Subject **PHYSICS**
Strand **3. ELECTRIC FIELD, MAGNETIC FIELD AND ELECTRONICS**
Sub-Strand **1. DIRECT CURRENT**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
3.3.1.LO.1		
Using the knowledge on current electricity to solve problems involving resistance and power in electrical circuits.	**Communication and collaboration**: learners will have to talk to their peers and interrogate findings from peers. **Digital literacy:** Learners will learn how to use ICT tools and their skills in ICT usage will be improved. **Creativity and problem-solving:** Learners become creative by navigating their way out to overcome challenges they encounter in carrying out the activity.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Demonstrate respect for diverse perspectives and experiences in physics. • Facilitate opportunities to share their diverse perspectives, experiences, and ideas in physics discussions and activities. **SEL:** Learning the concept of current electricity, learners cultivate essential skills for personal growth as they: • Demonstrate adaptability and flexibility in problem-solving processes. • Recognising resources and supports available through the family, school and the community. **National Core Values:** • Assertiveness

		• Resilience • Curiosity • Respect • Unity
3.3.1.LO.2		
Characterise resistors through calculation, identification and propose suitable resistors for a given electrical circuit.	Digital Literacy, Critical thinking, Creativity and problem-solving Communication and collaboration	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Actively work towards personal growth and overcoming these biases, promoting self-awareness and empathy. • Provide opportunities to highlight the contributions and achievements of historically underrepresented groups (including women, racial and ethnic minorities, and individuals with disabilities) in physics. **SEL:** Learning the characterise resistors, learners cultivate essential skills for personal growth as they: • Demonstrate respect for diversity among learners and find ways to share their cultural backgrounds and experiences. • Collaborate effectively in team settings. **National Core Values:** • Assertiveness

		• Resilience • Curiosity • Respect • Unity
3.3.1.LO.3		
Explain the Kirchhoff's laws and applications.	**Critical thinking**: Leaners will have to analyse and evaluate to form their judgement. **Digital Literacy**: Learners will use IT and digital technology to find, evaluate, create and communicate information **Communication and Collaboration**: Leraners seamlessly exchange information and discuss topics as a team in order to achieve a common goal. **Problem solving**: Learners will identify the problem, analyse possible solutions, and implement the best possible solution. **Creativity and innovation:** learners will be able to think of novel ideas and convert them into possible solutions	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Encourage teamwork and cooperation among learners from diverse backgrounds, fostering the development of essential skills for working effectively with individuals from different genders, cultures, and identities. • Establish classroom norms and practices that foster respect, empathy, and inclusivity, ensuring all learners feel valued, supported, and free from discrimination or harassment based on gender, race, ethnicity, or ability. **SEL:** Learning the concept of electromagnetic induction, learners cultivate essential skills for personal growth as they: • Communicate their findings clearly and coherently.

		• Making caring choices whilst managing emotions, thoughts and behaviours. **National Core Values:** • Assertiveness • Resilience • Curiosity • Respect

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI				Assessment
3.3.1.CS.1	3.3.1.LI.1				3.3.1.AS.1
Demonstrate an understanding of current electricity and its related quantities.	**Explain the key terminologies of circuitry and how they are related to one another.** **Talk for learning:** Recall and derive the quantities of electricity (e.g., load, source, switch/key, closed circuit, open circuit, electric charge, resistance, potential difference, emf, internal resistance and lost volts). **Collaborative learning:** In groups, research and explain the differences between conventional current flow and electron flow and draw appropriate circuit diagrams to explain this. Ensure that the teaching materials, examples, and illustrations reflect diverse perspectives				Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
	3.3.1.LI.2				3.3.1.AS.2
	Express Ohm's law and its relationship to electrical resistance; ohmic and non ohmic conductors **Experiential learning:** Using ammeter, voltmeter, standard resistor, rheostat/resistance box, connecting wires and a key, learners should perform an experiment to show the relationship between voltage and current. Provide equitable access to resources and opportunities.				Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Audio-visuals • Internet, • Projectors	• YouTube • Interactive virtual laboratory • Connecting wires	• Ammeter • Galvanometer • Voltmeter	• Resistance box • Rheostats	

<table>
<tr><th>Content Standards</th><th colspan="4">Learning Indicators and Pedagogical Exemplars with 21st Century and GESI</th><th>Assessment</th></tr>
<tr><td>3.3.1.CS.2</td><td colspan="4">3.3.1.LI.1</td><td>3.3.1.AS.1</td></tr>
<tr><td rowspan="3">Demonstrate knowledge and understanding of the structure and working principles of resistors.</td><td colspan="4">Describe and demonstrate the structure and working principle of resistors and their arrangements in circuits.

Experiential learning:
• Set up the laboratory for learners to arrange resistors in series and parallel and let learners conclude as far as current and voltage are concerned.
• Expound on the characteristics of a material with respect to resistivity and how it affects electrical conductivity.
• Explain the relationship between resistivity, length and area and apply the formula R=pl/A.

Ensure that the teaching materials, examples, and illustrations reflect diverse perspectives.</td><td>Level 1 Recall
Level 2 Skills of conceptual understanding
Level 3 Strategic reasoning
Level 4 Extended critical thinking and reasoning</td></tr>
<tr><td colspan="4">3.3.1.LI.2</td><td>3.3.1.AS.2</td></tr>
<tr><td colspan="4">Describe and demonstrate the types of variable resistors i.e., potentiometers and rheostats and their working principles.

Collaborative and Experiential learning:
• In pairs, learners identify the types of variable resistors.
• Learners describe how variable resistors are used in electrical circuits.

Ensure that the teaching materials, examples, and illustrations reflect diverse perspectives.</td><td>Level 1 Recall
Level 2 Skills of conceptual understanding
Level 3 Strategic reasoning
Level 4 Extended critical thinking and reasoning</td></tr>
<tr><td>Teaching and Learning Resources</td><td>• Audio-visuals
• Internet
• Projectors</td><td>• YouTube
• Interactive virtual laboratory,
• Connecting wires</td><td>• Ammeter
• Galvanometer
• Voltmeter</td><td>• Resistance box
• Rheostats
• Standard resistors</td><td></td></tr>
</table>

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI				Assessment
3.3.1.CS.3	3.3.1.LI.1				3.3.1.AS.1
Demonstrate knowledge and understanding of Kirchhoff's laws of electrical network.	**State Kirchhoff's laws of electrical network.** **Talk for learning:** Describe and apply Kirchhoff's voltage and current laws and solve appropriate problems. Recognise diverse talents and perspectives.				**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	3.3.1.LI.2				3.3.1.AS.2
	Determine the current flowing through a branch in an electrical network. **Talk for learning:** Explain and identify voltage and current dividers and solve appropriate problems. Recognise diverse talents and perspectives.				**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	3.3.1.LI.3				3.3.1.AS.3
	Discuss how a galvanometer can be adapted as an ammeter and a voltmeter **Experiential learning:** Provide learners with milliammeter, resistor, connecting wire and a dc source. Let learners design a circuit that will allow only ten milliamperes of current to pass through the galvanometer. Provide equitable access to resources and opportunities.				**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Audio-visuals • Internet • Projectors	• YouTube • Interactive virtual laboratory • Connecting wires	• Ammeter • Galvanometer • Voltmeter	• Resistance box • Rheostats • Standard resistors	

Subject **PHYSICS**
Strand **3. ELECTRIC FIELD, MAGNETIC FIELD AND ELECTRONICS**
Sub-Strand **2. ALTERNATING CURRENT**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
3.3.2.LO.1		
Describe alternating current and utilise the associated mathematical relationships	**Communication and collaboration:** Learners will have to talk to their peers and interrogate findings from peers. **Digital literacy:** Learners will learn how to use ICT tools and their skills in ICT usage will be improved. **Critical thinking:** Learners will develop this skill from deductions they make from equations.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Engage in self-reflection, examining their biases and assumptions about gender and social inclusion in physics. • Develop an understanding of gender equality in physics, recognising that all genders have the potential to excel in the field and contribute to scientific advancements **SEL:** Learning the concept of alternating current, learners cultivate essential skills for personal growth as they: • Value diverse contributions and support each other's learning. • Establish and maintain healthy relationships. **National Core Values:** • Assertiveness

		• Resilience • Curiosity • Respect
3.3.2.LO.2		
Illustrate and describe the behaviour of alternating current	**Communication and collaboration:** Learners will have to talk to their peers and interrogate findings from peers. **Digital literacy:** Learners will learn how to use ICT tools and their skills in ICT usage will be improved. **Critical thinking:** Learners will develop this skill from deductions they make from equations.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Develop the skills and confidence to advocate for gender equality and social inclusion in the physics community and beyond, promoting awareness, dialogue, and action to address systemic barriers and biases. • Facilitate opportunities to share their diverse perspectives, experiences, and ideas in physics discussions and activities. **SEL:** Learning the concept of alternating current, learners cultivate essential skills for personal growth as they: • Value diverse contributions and support each other's learning. • Establish and maintain healthy relationships. **National Core Values:** • Assertiveness • Respect • Resilience • Curiosity

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
3.3.2.CS.1	3.3.2.LI.1	3.3.2.AS.1
Demonstrate knowledge and understanding of Alternating Current Theory.	**Discuss the characteristics of alternating current/voltage.** **Collaborative learning:** Using the videos and simulation as well as internet/reference books let learners research to find the meaning of the following (i) Peak current Io, (ii) Peak voltage Vo, (iii) Root mean square value of alternating current I rms (iv) root mean square value of alternating voltage Vrms terms. Provide equitable access to resources and opportunities.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	3.3.1.LI.2	3.3.2.AS.2
	Distinguish between the types of AC waveforms. **Collaborative learning:** Using the videos and simulation as well as internet/reference books let learners research to find the meaning of the following (i) Peak current Io, (ii) Peak voltage Vo, (iii) Root mean square value of alternating current I rms (iv) root mean square value of alternating voltage V rms terms. Provide equitable access to resources and opportunities.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	3.3.2.LI.3	3.3.2.AS.3
	Using mathematical relationships define Alternating current and alternating voltage. **Collaborative learning:** Using the videos and simulation as well as internet/reference books let learners research to find the meaning of the following (i) Peak current Io, (ii) Peak voltage Vo, (iii) Root mean square value of alternating current Irms (iv) root mean square value of alternating voltage Vrms terms. Explore contributions of vulnerable groups in the class.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Audio-visuals • Internet • Projectors • YouTube • Interactive virtual laboratory • Reference books	

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
3.3.2.CS.2	3.3.2.LI.3	3.3.2.AS.3
Explain the a.c series connected circuit	**Describe a.c. circuit connections using resistors, inductors, capacitors in series.** **Experiential learning:** • Let learners watch videos on direct and alternating current to see how the current changes with time. • Guide learners to use appropriate equations to establish equations for pure capacitive, pure inductive and pure resistive circuits. • Let learners use sketched graphs to explain the behaviour of a.c in capacitor, inductor and resistor. Encourage diverse perspectives and contributions.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	3.3.2.LI.2	3.3.2.AS.2
	Describe and distinguish between reactance and impedance. **Experiential learning:** • Guide learners to establish equations for resistive reactance, capacitive reactance and inductive reactance from exemplar 1. • Let learners derive the formula for impedance using phasor diagrams for resistor-inductor in series, resistor-capacitor in series and resistor-capacitor-inductor in series. Encourage the appreciation and valuing of the skills and abilities of individuals from diverse backgrounds, including gender, race, ethnicity, socioeconomic status, and disabilities.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	3.3.2.LI.3	3.3.2.AS.3
	Describe the power triangle and explain the power factor using mathematical concepts. **Experiential learning:** Let learners discuss the conditions for resonance in a.c in R-C, R-L, and R-L-C series circuits. Let learners discuss the application of resonance in selecting a particular frequency in radio reception and transmission. Let learners discuss the power factor.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning**

	Challenge stereotypes and misconceptions about gender and disabilities in physics.		Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Audio-visuals, • Internet	• Projectors • YouTube	• Interactive virtual laboratory • Reference books

Subject **PHYSICS**
Strand **3. ELECTRIC FIELD, MAGNETIC FIELD AND ELECTRONICS**
Sub-Strand **3. ELECTROMAGNETIC INDUCTION & APPLICATIONS**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
3.3.3.LO.1		
Use the concept of electromagnetic induction to explain how electricity can be generated.	**Critical thinking:** Learners will have to analyse and evaluate to form their judgement. **Digital Literacy:** Learners will use IT and digital technology to find, evaluate, create and communicate information. **Communication and Collaboration:** Learners seamlessly exchange information and discuss topics as a team in order to achieve a common goal. **Problem solving:** Learners will identify the problem, analyse possible solutions, and implement the best possible solution. **Creativity and innovation:** Learners will be able to think of novel ideas and convert them into possible solutions.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Encourage teamwork and cooperation among learners from diverse backgrounds, fostering the development of essential skills for working effectively with individuals from different genders, cultures, and identities. • Establish classroom norms and practices that foster respect, empathy, and inclusivity, ensuring all learners feel valued, supported, and free from discrimination or harassment based on gender, race, ethnicity, or ability. **SEL:** Learning the concept of electromagnetic induction, learners cultivate essential skills for personal growth as they:

		• Communicate their findings clearly and coherently. • Making caring choices whilst managing emotions, thoughts and behaviours. **National Core Values:** • Assertiveness • Resilience • Curiosity • Respect
3.3.3.LO.2		
Explain the working principles of inductors and their applications.	**Critical thinking:** Learners will have to analyse and evaluate to form their judgement. **Digital Literacy:** Learners will use IT and digital technology to find, evaluate, create and communicate information. **Communication and Collaboration:** Learners seamlessly exchange information and discuss topics as a team in order to achieve a common goal. **Problem solving:** Learners will identify the problem, analyse possible solutions, and implement the best possible solution. **Creativity and innovation:** Learners will be able to think of novel ideas and convert them into possible solutions.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Avoid perpetuating stereotypes, biases, or exclusionary language that may reinforce gender or social inequities. • Examine and challenge societal gender stereotypes and biases that may limit or discourage certain genders from pursuing physics. **SEL:** Learning the principles of inductors, learners cultivate essential skills for personal growth as they: • Develop goal-setting and self-motivation strategies. • Manage their emotions and behaviours effectively to achieve goals and aspirations.

		National Core Values: • Adaptability • Assertiveness • Resilience • Curiosity • Respect
3.3.3.LO.3		
Describe the structure, principle of operation and applications of a transformer.	**Critical thinking:** Learners will have to analyse and evaluate to form their judgement. **Digital Literacy:** Learners will use IT and digital technology to find, evaluate, create and communicate information. **Communication and Collaboration:** Learners seamlessly exchange information and discuss topics as a team in order to achieve a common goal. **Problem solving:** Learners will identify the problem, analyse possible solutions, and implement the best possible solution. **Creativity and innovation**: Learners will be able to think of novel ideas and convert them into possible solutions.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Promote an inclusive learning environment that values and respects all voices. • Actively work towards personal growth and overcoming these biases, promoting self-awareness and empathy. **SEL:** Learning the principle of operation and applications of transformers, learners cultivate essential skills for personal growth as they: • Communicate their findings clearly and coherently. • Promote intellectual humility and openness to alternative perspectives. **National Core Values:** • Assertiveness • Resilience

		• Curiosity • Respect

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
3.3.3.CS.1	3.3.3.LI.1	3.3.3.AS.1
Demonstrate knowledge and understanding of electromagnetic induction.	**Explain electromagnetic induction.** **Talk for learning:** Describe electromagnetic induction and applications in daily lives. Investigate and discuss the historical and contemporary contributions of individuals, including women and individuals with disabilities, to the development of the concept of electromagnetic induction and its applications.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	3.3.3.LI.2	3.3.3.AS.2
	Using experimentation, verify the laws of electromagnetic induction. **Collaborative learning:** In groups of mixed abilities, describe experiments to verify the laws of electromagnetic induction. Describe the observations of Faraday and the development of Faraday's law. Describe the observations of Lenz and the development of the Lenz law. Investigate and discuss the historical and contemporary contributions of individuals, including women and individuals with disabilities, to the development of the concept of electromagnetic induction and its applications.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	3.3.3.LI.3	3.3.3.AS.3
	Describe the factors that affect induced emf and explain direction of induced current using mnemonics of the Fleming's Right Hand Rule. **Talk for learning:** Describe the factors that affect the magnitude of induced emf. Using mnemonics, explain Fleming's Right Hand Rule Foster an inclusive and supportive learning environment.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Audio-visuals • Projectors,	• YouTube • Interactive virtual laboratory • Practical laboratory setup • Reference books.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
3.3.3.CS.2	3.3.3.LI.1	3.3.3.AS.1
Demonstrate knowledge and understanding of induction.	**Explain inductance and obtain a mathematical expression for the relationship.** **Talk for learning:** Describe and distinguish between inductance and an inductor Explain the factors that affect inductance: • number of wire turns in a coil • coil area • core material • coil length Recall and apply Faraday's law to determine inductance Explain and differentiate self-inductance and mutual inductance Foster respect and inclusion in physics, creating an inclusive and welcoming classroom environment that values the contributions of individuals from all backgrounds and genders.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	3.3.3.LI.2	3.3.3.AS.2
	Discuss the behaviour of the inductor in a.c and d.c circuits. **Talk for learning:** • Discuss the operations of a bicycle dynamo. • Discuss the operations of a simple a.c. generator. • Discuss the modification of an a.c. generator into d.c. generator. Recognise diverse talents and perspectives.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	3.3.3.LI.3	3.3.3.AS.3
	Explain how energy is stored in an inductor. **Talk for learning:** Recall kinetic energy and relate it to energy storage in an inductor. Explore contributions of vulnerable groups in the class.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning

Teaching and Learning Resources	• Audio-visuals • Internet	• Projectors • YouTube • Interactive virtual laboratory	• Practical laboratory setup • Reference books

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
3.3.3.CS.3	3.3.3.LI.1	3.3.3.AS.1
Demonstrate knowledge and understanding of the principles of operation of transformers.	**Discuss the structure, uses and principle of operation of a transformer.** **Experiential learning:** • Explain the structure of transformers and in mixed groups, perform experiments to understand how transformers work. • Recall and describe the use of magnetic materials as cores of transformers • Explain why transformers are used for alternating current and direct current Ensure that the teaching materials, examples, and illustrations reflect diverse perspectives.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
	3.3.3.LI.1.2	3.3.3.AS.1.2
	Discuss the factors that affect the transmission of power and efficiency of a transformer and ways of improving its efficiency. **Talk for learning:** • Describe the effect of transformers on the relationship between the potential difference and current of an electrical signal • Discuss the factors that affect transformer performance and efficiency. • Describe how these factors can be minimised Foster an inclusive and respectful classroom culture and address bias in teaching materials and examples.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
	3.3.3.LI.1.3	3.3.3.AS.1.3
	Explain Eddy current, effects and applications **Talk for learning:** • Recall Lenz law and explain Eddy Current. • In mixed groups, discuss how Eddy Current can be minimised • In mixed groups, describe the applications of Eddy current in induction furnace, speedometer and damping in galvanometer.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**

	Foster collaborations that broaden students' exposure to diverse physics-related career paths and role models.		
Teaching and Learning Resources	• Audio-visuals • Internet	• Projectors • YouTube • Interactive virtual laboratory	• Practical laboratory setup • Reference books

Subject **PHYSICS**
Strand **3. ELECTRIC FIELD, MAGNETIC FIELD AND ELECTRONICS**
Sub-Strand **4. APPLICATIONS OF ELECTRONICS**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
3.3.4.LO.1		
Using diode, capacitor and a load resistor explain how an ac waveform can be rectified to direct waveform.	**Critical thinking**: Learners will have to analyse and evaluate to form their judgement. **Digital Literacy:** Learners will use IT and digital technology to find, evaluate, create and communicate information. **Communication and Collaboration:** Learners seamlessly exchange information and discuss topics as a team in order to achieve a common goal. **Problem solving:** Learners will identify the problem, analyse possible solutions, and implement the best possible solution. **Creativity and innovation:** Learners will be able to think of novel ideas and convert them into possible solutions.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Examine and challenge societal gender stereotypes and biases that may limit or discourage certain genders from pursuing physics. • Avoid perpetuating stereotypes, biases, or exclusionary language that may reinforce gender or social inequities. **SEL:** Learning the concept of rectification, learners cultivate essential skills for personal growth as they: • Demonstrate respect for diversity among learners and find ways to share their experiences. • Develop strategies for completing a task or learning new concepts. **National lCore Values:** • Assertiveness

		• Resilience • Curiosity • Respect
3.3.4.LO.2		
Using a transistor explain how amplification is done.	**Critical thinking:** Learners will have to analyse and evaluate to form their judgement. **Digital Literacy:** Learners will use IT and digital technology to find, evaluate, create and communicate information. **Communication and Collaboration:** Learners seamlessly exchange information and discuss topics as a team in order to achieve a common goal. **Problem solving:** Learners will identify the problem, analyse possible solutions, and implement the best possible solution. **Creativity and innovation**: Learners will be able to think of novel ideas and convert them into possible solutions.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Promote gender equality and social inclusion in physics, allowing them to learn from diverse perspectives and aspire to various physics-related careers and opportunities. • Engage in self-reflection, examining their biases and assumptions about gender and social inclusion in physics. **SEL:** Learning the concept of amplification, learners cultivate essential skills for personal growth as they: • Demonstrate adaptability and flexibility in problem-solving processes. • Make constructive and respective choices about social interactions and personal behaviour. **National Core Values:** • Assertiveness • Resilience

		• Curiosity • Respect • Unity • Adaptability
3.3.4.LO.3		
Using a solar panel explain how a darkness detector works.	**Critical thinking:** Learners will have to analyse and evaluate to form their judgement. **Digital Literacy:** Learners will use IT and digital technology to find, evaluate, create and communicate information. **Communication and Collaboration:** Learners seamlessly exchange information and discuss topics as a team in order to achieve a common goal. **Problem solving:** Learners will identify the problem, analyse possible solutions, and implement the best possible solution. **Creativity and innovation:** Learners will be able to think of novel ideas and convert them into possible solutions.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Establish classroom norms and practices that foster respect, empathy, and inclusivity, ensuring all learners feel valued, supported, and free from discrimination or harassment based on gender, race, ethnicity, or ability. • Promote an inclusive and diverse representation of physicists. **SEL:** Learning the concept of sensors, learners cultivate essential skills for personal growth as they: • Develop strategies for goal setting. • Establishing and maintaining healthy relationships. **National Core Values:** • Assertiveness • Resilience • Curiosity • Respect • Teamwork

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
3.3.4.CS.1	3.3.4.LI.1	3.3.4.AS.1
Demonstrate knowledge and understanding of rectification.	**Design half wave rectifier.** **Collaborative learning:** Using simulations and multimedia, let learners watch a video/simulation of how a half wave rectifier is built. Engage with inclusive resources and role models in physics.	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
	3.3.4.LI.2	3.3.4.AS.2
	Design a full wave rectifier. **Collaborative learning:** Using simulations and multimedia, let learners watch a video/simulation of how a full wave rectifier is built. Encourage self-awareness and personal growth by fostering an environment where learners feel comfortable sharing their reflections and experiences.	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
	3.3.4.LI.3	3.3.4.AS.3
	Design a smoother/filter circuit using capacitor. **Collaborative learning:** Using simulations and multimedia, let learners watch a video/simulation of how a smoother/filter circuit is designed. Encourage the appreciation and valuing of the skills and abilities of individuals from diverse backgrounds, including gender, race, ethnicity, socioeconomic status, and disabilities.	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Audio-visuals • Internet • Projectors	• YouTube • Reference books • Flash cards • Field trips or visits

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI			Assessment
3.3.4.CS.2	3.3.4.LI.1			3.3.4.AS.1
Demonstrate knowledge and understanding of signal amplification.	**Design a PNP amplifier.** **Collaborative learning:** Using simulations and multimedia, let learners watch a video/simulation of how an PNP amplifier is built. Foster respect and inclusion, creating an inclusive and welcoming classroom environment that values the contributions of individuals from all backgrounds and genders.			Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
	3.3.4.LI.2			3.3.4.AS.2
	Design a NPN amplifier. **Collaborative learning:** Using simulations and multimedia, let learners watch a video/simulation of how an NPN amplifier is built. Provide equitable access to resources and opportunities.			Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Audio-visuals • Internet • Projectors	• YouTube • Reference books	• Flash cards • Field trips or visits	

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI			Assessment
3.3.4.CS.3	3.3.4.LI.1			3.3.4.AS.1
Demonstrate knowledge and understanding of darkness detector circuit.	**Design a darkness detector.** **Collaborative learning:** Using simulations and multimedia, let learners watch a video/simulation of how a darkness detector is built. Foster an inclusive and respectful classroom culture and address bias in teaching materials and examples.			Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
	3.3.4.LI.2			3.3.4.AS.2
	Design a battery charger. **Collaborative learning:** Using simulations and multimedia, let learners watch a video/simulation of how a battery charger is built. Engage learners in discussions and activities that examine prevalent myths or misconceptions surrounding race, gender and disabilities in the context of physics, encouraging critical thinking and dispelling these misconceptions through evidence-based exploration.			Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Audio-visuals • Internet • Projectors	• YouTube • Reference books	• Flash cards • Field trips or visits	

Subject **PHYSICS**
Strand **4. ATOMIC AND NUCLEAR PHYSICS**
Sub-Strand **1. ATOMIC PHYSICS**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
3.4.1.LO.1		
Recognise the applications of x-rays in medicine, and other industrial sectors.	**Communication and Collaboration:** learners must collaboratively engage one another develop the concept. **Critical thinking skills** of learners developed as they critique suggestions from their peers. **Digital literacy:** learners learn to use ICT tools thereby developing their digital literacy skills.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Examine and challenge societal gender stereotypes and biases that may limit or discourage certain genders from pursuing physics. • Provide opportunities to highlight the contributions and achievements of historically underrepresented groups (including women, racial and ethnic minorities, and individuals with disabilities) in physics. **SEL:** Learning the application of X-rays, learners cultivate essential skills for personal growth as they: • Contribute constructively to discussions and actively listen to peers' ideas. • Develop strategies for goal setting.

		National Core Values: • Assertiveness • Resilience • Curiosity • Respect • Teamwork

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
3.4.1.CS.1	3.4.1.LI.1	3.4.1.AS.1
Demonstrate knowledge and understanding of the production of x-rays.	**Describe how x-rays are produced** **Collaborative learning:** Using simulations and multimedia, let learners watch a video/simulation of how x- rays are produced. Encourage reflection on the potential impact of biases on individuals' opportunities and aspirations, and foster a commitment to promoting equitable access and representation in the field of radiation physics.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	3.4.1.LI.2	3.4.1.AS.2
	Distinguish between hard x-rays and soft x-rays **Experiential learning:** From the video learners must also come out with the characteristics and uses of x-rays. Challenge stereotypes and misconceptions about gender and disabilities in radiation physics.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	3.4.1.LI.3	3.4.1.AS.3
	Calculate the energy, frequency and wavelength of x-rays. **Experiential learning:** Let learners employ their knowledge in calculating the energy of a photon to determine the frequency of x-rays produced. Provide equitable access to resources and opportunities.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	3.4.1.LI.4	3.4.1.AS.4
	Identify sectors where x-rays are applied and how they are applied **Experiential learning:** Use the video to explore some industrial and health applications of x-rays. Encourage diverse perspectives and contributions.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning

			Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Audio-visuals	• Internet • Projectors	• YouTube • Interactive virtual laboratory

Subject **PHYSICS**
Strand **4. ATOMIC AND NUCLEAR PHYSICS**
Sub-Strand **2. NUCLEAR PHYSICS**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
3.4.2.LO.1		
Recognise the amount of energy released from nuclear reactions	**Communication and Collaboration:** learners must collaboratively engage one another develop the concept. **Critical thinking skills** of learners developed as they critique suggestions from their peers. **Digital literacy:** Learners learn to use ICT tools thereby developing their digital literacy skills.	**GESI:** Learners having experienced various teaching methods that ensure gender equality and inclusively working with each other, cross-sharing knowledge and understanding among groups and individuals lead them to: • Facilitate opportunities to share their diverse perspectives, experiences, and ideas in physics discussions and activities. • Demonstrate respect for diverse perspectives and experiences in physics. **SEL:** Learning the concepts of nuclear reactions, learners cultivate essential skills for personal growth as they: • Value diverse contributions and support each other's learning. • Embrace challenges and view mistakes as opportunities for learning and improvement. **National Core Values:** • Resilience

		• Courage • Patience • Adaptability

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
3.4.2.CS.1	3.4.2.LI.1	3.4.2.AS.1
Demonstrate knowledge and understanding of the atom as an agent for energy production	**Calculate the energy released in a nuclear reaction** **Enquiry learning:** • Guide learners to find the relationship between mass and energy through research. • Let learners discuss the mass defect, binding energy and binding energy per nucleon. Ensure that the teaching materials, examples, and illustrations reflect diverse perspectives.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	3.4.2.LI.2	3.4.2.AS.2
	Distinguish between fission and fusion **Collaborative learning:** Using simulations and multimedia, let learners come out with the differences between fission and fusion reactions. Engage learners in discussions and activities that examine prevalent myths or misconceptions surrounding gender and disabilities in the context of nuclear science, encouraging critical thinking and dispelling these misconceptions through evidence-based exploration.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	3.4.2.LI.2	3.4.2.AS.3
	Describe the process of power generation using a nuclear reactor. **Experiential learning:** Let learners watch a video/simulation of how power is generator with a nuclear reactor. Investigate and discuss the historical and contemporary contributions of individuals, including women and individuals with disabilities, to the development of nuclear science.	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Audio-visuals • Internet • Projectors • YouTube • Interactive virtual laboratory	