COMPUTING

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.

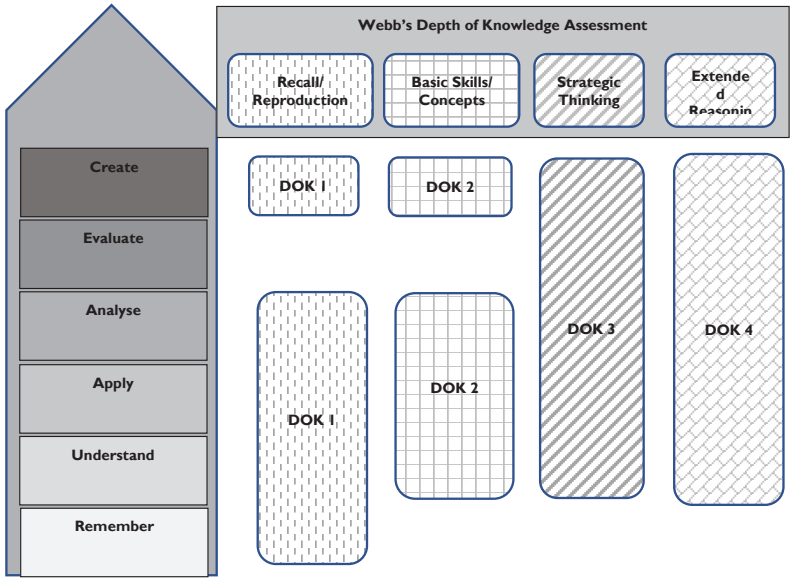

Figure 1: Revised Bloom Taxonomy combined with Webb's Depth of Knowledge for Teaching and Assessment

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 COMPUTING

Philosophy

The next generation of ethical creators and developers of technology can be empowered through observation, curiosity, exposure to related computing concepts and opportunities that leverage hands-on activities in a learner-centred environment leading to local and global relevance.

Vision

To prepare learners with 21st Century skills and competencies to ethically design, develop and apply computing systems to solve real-world problems.

Goal

To equip learners with knowledge, skills and tools to create and develop technologies in a responsible manner that will solve problems in society and promote lifelong learning.

Contextual Issues

Ghanaian schools lack ICT infrastructure, due to the high cost of computers and other technologies, poor internet connectivity, intermittent power fluctuations, and teachers' inadequate knowledge or technical know-how in using ICT tools in teaching are the associated contextual issues with the integration of ICT. Again, Security Concerns, Widening Skill Gaps, The Rise of Robotics, and Business Continuity are some of the contextual issues that have been looked at in this Computing Curriculum.

Some contemporary issues in computing that need immediate action are cyberbullying, copyright infringement, green technology, and Internet addiction. There is, therefore, the need to promote Computing through responsible thinking, mutual understanding, and alertness of everyone on the Internet.

This Computing Curriculum will develop the desire and competencies in learners to use ICTs, equip secondary school computing graduates with ICT skills, infuse ICT into education management, and transform teacher development and secondary education through technology-based teaching and learning.

Rationale

The accelerated expansion of computing technologies and artificial intelligence in the world requires that learners have to understand the principles of Computing now, more than ever before. It is necessary for learners to understand the ethical and social role of computers in society, in the areas of digital electronics, computing technologies, and Computational thinking, which are some of the most fundamental skills acquired through the study of computing. It shares characteristics with other sciences, such as problem-solving, abstraction and logical reasoning. However, computational thinking involves the implementation of solutions using automation, programming and computer systems. Learners studying this subject will gain both theoretical and practical skills that are valuable beyond the classroom and are applicable in many contexts.

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SCOPE AND SEQUENCE

Computing Summary

S/N	STRAND	SUB-STRAND	YEAR 1			YEAR 2			YEAR 3		
			CS	LO	LI	CS	LO	LI	CS	LO	LI
1.	Computer Architecture and Organisation	Data Storage and Manipulation	1	1	4	1	1	3	1	1	3
		Computer Hardware and Software	1	1	2	1	1	2	1	1	2
		Data Communication and Network Systems	1	1	3	1	1	3	1	1	3
2.	Computational Thinking (Programming Logic)	Algorithm and Data Structure	1	1	2	1	1	2	1	1	1
		App Development	1	1	2	1	1	2	1	1	2
		Web Technologies and Databases	1	1	2	1	1	3	1	1	3
Total			**6**	**6**	**15**	**6**	**6**	**15**	**6**	**6**	**15**

Overall Totals (SHS 1 – 3)

Content Standards	18
Learning Outcomes	18
Learning Indicators	46

YEAR ONE

Subject COMPUTING
Strand 1. COMPUTER ARCHITECTURE AND ORGANISATION
Sub-Strand 1. DATA STORAGE AND MANIPULATION

Learning Outcomes	21st Century Skills and Competencies	GESI[1], SEL[2] and Shared National Values
1.1.1.LO.1		
Apply Computer Architecture concepts related to the design of modern processors, memories, Input and Output to manipulate data.	**Critical Thinking and Problem-Solving**: Learners exhibit the ability to analyse, evaluate, and solve complex problems using logical and creative thinking in the Application of Computer Architecture concepts. **Creativity and Innovation**: Learners exhibit the capacity to generate original ideas, think outside the box, and approach tasks with a fresh perspective with respect to the Application of Computer Architecture concepts. **Collaboration and Teamwork**: The ability to work effectively in diverse groups, value different perspectives, and contribute collectively towards shared goals.	**GESI:** As all learners are supported in an inclusive environment and given equal opportunities they will; • appreciate, value, and embrace diversity as they work in groups. • learn to amicably resolve conflicts and embrace different opinions. • develop emotional intelligence as their submissions are critiqued by others. **SEL:** Learners strive to attain and utilise knowledge, skills, and attitudes that enable them to: • cultivate a positive sense of self and foster healthy relationships with different identities while applying Computer Architecture concepts. • effectively navigate and regulate their emotions. • set and accomplish personal and collaborative objectives. • demonstrate understanding and compassion towards others, exhibiting empathy. • create and sustain supportive connections with peers and individuals around them. • exercise thoughtful judgement and act responsibly and compassionately in decision-making processes.

[1] Gender Equality and Social Inclusion

[2] Socio-Emotional Learning

		By integrating these SEL features into the teaching of Computer Architecture concepts, teachers can create a supportive and inclusive learning environment. This approach promotes learners' emotional well-being, enhances their collaborative and communication skills, and fosters responsible decision-making in applying Computer Architecture concepts related to the design of modern processors, memories, Input and Output to manipulate data **National core values:** • Tolerance • Integrity • Accountability • Humility • Assertiveness • Patriotism

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 data representation and Data Manipulation	**Describe Information as Bit Patterns** **Group Work/Collaborative Learning:** Interactive presentations, video analysis and debate. e.g., Divide the class into two mixed-ability groups and task them to Describe Information as Bit Patterns. The groups must respond to inclusivity and equity. For example, learners with visual impairment, dyslexia, and dysgraphia should be considered.	**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
	Apply knowledge of Cache Memory to solve runtime issues. (e.g., opening browsers). **Group Activity:** • In groups, let learners brainstorm on the purpose and functioning of cache (temporal local storage) in modern processors. • Have learners apply their understanding by analysing and discussing real-world scenarios where cache utilisation can enhance system performance. • Provide opportunities for individual or group practice to identify and troubleshoot runtime errors caused by cache-related issues.	**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
	Discuss at least four major functions and the parts of the CPU; Arithmetic and Logic Unit (ALU), Control Unit (CU) and registers **Using Talk for Learning approaches (TfL) or snowballing**: • Task each learner to state a specific function or method in programming, and then randomly call on another learner to explain the purpose, input, and expected output of the stated function. • Assess learners based on the accuracy and clarity of their explanations, as well as their ability to demonstrate comprehension of functions and their application in data manipulation.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning

	1.1.1.LI.4		1.1.1.AS.4
	Understand and explain the control bus, address bus, data bus and the internal clock, Machine Cycle, Von Neumann architecture (Fetch–Decode–Execute-Store Cycle), instruction set for a CPU, Harvard architecture and embedded systems **Group Activity:** • In groups, let learners collaborate and brainstorm on the following components and concepts of Computer Architecture: Control Bus, Address Bus, Data Bus, Internal Clock, Machine Cycle, Von Neumann **architecture** (Fetch-Decode-Execute-Store Cycle), and Instruction set for CPU. • Guide the group discussions by providing prompts and questions that encourage in-depth exploration of each component or concept. • Assess learners based on their ability to articulate the purpose, functioning, and interconnections among these components and concepts, as well as their ability to relate them to data manipulation.		**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Notepad or exercise book • Pen • Smartphones • Laptops	• Desktop computers • Tablets • TV and Radio • Open Educational Resources (including YouTube, MOOCs - Udemy/Coursera, Khan Academy, and TESSA)	• The iBox/iCampus (CENDLOS) • Productivity tools ix. Subject-based application software • Instructional Laboratories (with multimedia equipment and smartboards) • Maintenance and repair workshops

Subject **COMPUTING**
Strand **1. COMPUTER ARCHITECTURE AND ORGANISATION**
Sub-Strand **2. COMPUTER HARDWARE AND SOFTWARE**

Learning Outcomes	**21st Century Skills and Competencies**	**GESI, SEL and Shared National Values**
1.1.2.LO.1		
Explain the relationships between the components of a computer and how data are transferred among the components. Explain types of Software and their functions	**Critical Thinking and Problem-Solving**: Learners exhibit the ability to analyse, evaluate, and solve complex problems using logical and creative thinking in components of a computer and how data are transferred among the components. **Communication**: The skill to effectively express ideas and information through various mediums and engage in active listening and sharing information by peer-to-peer, presentation etc. **Collaboration and Teamwork**: **The ability to work effectively in diverse groups, value different perspectives, and contribute collectively towards shared goals.** **Digital Literacy**: The competence to use digital technologies, navigate online information, and apply digital tools effectively and responsibly.	**GESI:** As all learners are supported in an inclusive environment and given equal opportunities they will; • embrace tolerance and empathy among each other. • learn to resolve conflicts and embrace differing opinions amicably. • develop emotional intelligence as others critique their submissions. **SEL:** Learners acquire and use knowledge, skills, and attitudes to: • reflect on their own understanding of computer components, data transfer and software functions. • effectively navigate and regulate their emotions and self-confidence. • set and accomplish personal and collaborative objectives. • create and sustain supportive connections with peers and individuals around them. • set and pursue both personal and shared goals.

		• inform decisions when selecting appropriate processors, memories, and input/output devices to optimise data manipulation. By integrating these SEL features into teaching of the components of a computer, teachers can create a supportive and inclusive learning environment. This approach promotes learners' emotional well-being, enhances their collaborative and communication skills, and fosters responsible decision-making in explaining the relationships between the components of a computer and how data are transferred among the components. **National core values:** • Hard work • Integrity • Accountability • Humility • Assertiveness • Patriotism

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 components of Computer Hardware and types of Software	**Explain the features of the hardware components of a computer (input hardware, processing hardware, output hardware, storage hardware and communication hardware).** **Group Work/Talk for Learning**: • Use think-pair-share to discuss the features of the hardware components of a computer • In groups, brainstorm on the features of the hardware components of a computer (input hardware, processing hardware, output hardware, storage hardware and communication hardware). Give all learners equal opportunity and use webbing to organise the views of the learners. **SEL:** When teaching about the hardware components of a computer teachers can integrate Social Emotional Learning (SEL) principles to create an engaging and supportive learning experience. Here are some SEL features you can incorporate into this specific topic: **Self-awareness:** • provides opportunities for self-assessment of their skills and progress in applying these concepts to manipulate data. • helps students recognise their emotions and attitudes towards the topic, supporting their self-confidence and self-efficacy. **Self-management:** • guides students in setting goals and planning their work • fosters resilience and perseverance by supporting students in managing challenges and setbacks they may encounter during the learning process. **Social awareness:** • promotes collaborative learning by assigning group projects or activities to learners • encourages students to share their knowledge and expertise with their peers, creating a supportive learning community.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning

	Relationship skills: • promotes teamwork and collaboration by encouraging students to work together to solve complex problems and share their insights and solutions. • emphasises the value of giving and receiving constructive feedback **Responsible decision-making:** • encourages learners to make informed decisions. • encourages critical thinking and reflection		
	1.1.2.LI.2		1.1.2.AS.2
	Describe the categories of Computer Hardware **Problem-Based Learning Approach**: In different task groups, Task learners to identify and explain the categories of Computer Hardware: • input devices • processing devices • output devices • storage devices. • communication devices. Groups working on different tasks present their tasks for comments. Groups should be tolerant of others' views.		**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Notepad or exercise book • Pen • Smartphones • Laptops	• Desktop computers • Tablets • TV and Radio • Open Educational Resources (including YouTube, MOOCs - Udemy/Coursera, Khan Academy, and TESSA)	• The iBox/iCampus (CENDLOS) • Productivity tools ix. Subject-based application software • Instructional Laboratories (with multimedia equipment and smartboards) • Maintenance and repair workshops

Subject **COMPUTING**
Strand **1. COMPUTER ARCHITECTURE AND ORGANISATION**
Sub-Strand **3. DATA COMMUNICATION AND NETWORK SYSTEMS**

Learning Outcomes	**21st Century Skills and Competencies**	**GESI, SEL and Shared National Values**
1.1.3.LO.1		
Use skills and knowledge to identify and differentiate between the different types of Network Systems	**Critical Thinking and Problem-Solving**: Learners exhibit the ability to analyse, evaluate, and solve complex problems using logical and creative thinking in identifying and differentiate between the different types of Network Systems **Creativity and Innovation**: Learners exhibit the capacity to generate original ideas, think outside the box, and approach tasks with a fresh perspective with respect to the Application of Computer Architecture concepts **Digital Literacy**: The competence to use digital technologies, navigate online information, and apply digital tools effectively and responsibly.	**GESI:** Providing the opportunity for diverse learners to actively participate in all lessons in an inclusive manner and using GESI responsive language as pedagogy ensures; • awareness of personal biases and stereotypes in the area of analysing the scope of common methods in computing. • respect and tolerance for an individual's uniqueness and peculiarities. • sensitivity to the interrelatedness of the various spheres of life, groups, and individuals. **SEL:** Learners gain and utilise knowledge, abilities, and mindsets to: • cultivate a robust and optimistic self-perception, fostering the growth of healthy identities. • skillfully handle their emotions, fostering emotional well-being. • establish and achieve personal and collaborative objectives, nurturing progress and accomplishment.

		• nurture empathy towards others, exhibiting understanding and compassion. • build and maintain supportive connections, fostering a sense of belonging. • exercise responsible and compassionate judgment, considering the well-being of themselves and others. By integrating these SEL features into the teaching of Network Systems, teachers can create a supportive and inclusive learning environment. This approach promotes learners' emotional well-being, enhances their collaborative and communication skills, and fosters responsible decision-making in using skills and knowledge to identify and differentiate between the different types of Network Systems. **National core values:** • Patriotism • Faithfulness • Honesty • Loyalty • Discipline • Respect • Humility • Assertiveness • Good citizenship

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 network design	**Explain Computer Networks and how they work** **Using the Collaborative Learning Approach**: Demonstrate the process of designing a network topology based on specific requirements and explain the rationale behind the chosen design. **Using the Problem-Based Learning Approach**: Explore and discuss the concepts of control bus, address bus, data bus, cache, internal clock, machine cycle, and the fetch-decode-execute cycle to deepen understanding. **SEL:** When teaching students about Computer Networking, you can integrate Social Emotional Learning (SEL) principles to create an engaging and supportive learning experience. Here are some SEL features you can incorporate into this specific topic: **Self-awareness:** • provides opportunities for self-assessment of their skills and progress in applying these concepts to manipulate data. • helps students recognise their emotions and attitudes towards the topic, supporting their self-confidence and self-efficacy. **Self-management:** • guides students in setting goals and planning their work • fosters resilience and perseverance by supporting students in managing challenges and setbacks they may encounter during the learning process. **Social awareness:** • promotes collaborative learning by assigning group projects or activities to learners • encourages students to share their knowledge and expertise with their peers, creating a supportive learning community.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning

	Relationship skills: • promotes teamwork and collaboration by encouraging students to work together to solve complex problems and share their insights and solutions. • emphasises the value of giving and receiving constructive feedback **Responsible decision-making:** • encourages learners to make informed decisions. • encourages critical thinking and reflection	
	1.1.3.LI.2	1.1.3.AS.2
	Identify at least 3 Types of Network Systems **Problem-Based Learning:** Analyse and present the features and functions of hardware components commonly found in network systems, such as routers, switches, network interface cards (NICs), and modems.	**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
	Differentiate among the 3 Types of Network Systems **Using the Collaborative Learning Approach:** • engage in a group brainstorming session to identify and classify various types of network systems. • provide examples for each type to support your classification and explain the characteristics that distinguish them.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Notepad or exercise book • Pen • Smartphones • Laptops • Desktop computers • Tablets	• TV and Radio • Open Educational Resources (including YouTube, MOOCs - Udemy/Coursera, Khan Academy, and TESSA) • The iBox/iCampus (CENDLOS) • Productivity tools ix. Subject-based application software • Instructional Laboratories (with multimedia equipment and smartboards) • Maintenance and repair workshops

Subject **COMPUTING**
Strand **2. COMPUTATIONAL THINKING (PROGRAMMING LOGIC)**
Sub-Strand **1. ALGORITHM AND DATA STRUCTURE**

Learning Outcomes	**21st Century Skills and Competencies**	**GESI, SEL and Shared National Values**
1.2.1.LO.1		
Apply knowledge of data structures to explain their real-life applications effectively.	**Communication**: The skill to effectively express ideas and information through various mediums and engage in active listening by peer-to-peer method, presentation etc. **Collaboration and Teamwork**: The ability to work effectively in diverse groups, value different perspectives, and contribute collectively towards shared goals while explaining data structures. **Digital Literacy**: The competence to use digital technologies, navigate online information, and apply digital tools effectively and responsibly.	• **GESI:** As facilitators steer discussions, they are mindful to stay off biases, stereotypes, and prejudices and place efforts to provide well-balanced examples. This will make learners; • aware of their personal biases and stereotypes, embrace diversity, and practise inclusion. • embrace tolerance and empathy among each other. • develop emotional intelligence as others critique their submissions. • learn to listen to others of different genders and abilities, thus developing tolerance and listening skills. **SEL:** Learners acquire and apply knowledge, skills, and attitudes in order to: • foster a strong and positive sense of self, nurturing the development of healthy identities. • effectively manage their emotions, promoting overall emotional well-being.

		• set and achieve personal and collective goals, fostering growth and accomplishment. • cultivate empathy for others, demonstrating understanding and compassion. • establish and sustain supportive relationships, promoting a sense of belonging. • make responsible and compassionate decisions, taking into consideration the well-being of themselves and others. By integrating these SEL features into the teaching of data structures, teachers can create a supportive and inclusive learning environment. This approach promotes learners' emotional well-being, enhances their collaborative and communication skills, and fosters responsible decision-making in using knowledge of data structures to explain the applications in real life. **National core values:** • Tolerance • Friendliness • Open-mindedness • Patience • Commitment • Hard work

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
1.2.1.CS.1	1.2.1.LI.1	1.1.1.AS.1
Demonstrate knowledge and understanding of Data Structures	**Explain in detail the concepts of Data Structures and their importance in organising and manipulating data efficiently.** **Problem-Based Learning:** Brainstorm and discuss the importance and practical applications of data structures, providing examples to illustrate their relevance in different scenarios. **Group Work/Talk for Learning:** Engage in collaborative activities such as think-pair-share or small group discussions to define data structures in their own words, promoting a deeper understanding through shared perspectives. **SEL:** When teaching students about Data Structures and their importance, you can integrate Social Emotional Learning (SEL) principles to create an engaging and supportive learning experience. Here are some SEL features you can incorporate into this specific topic: **Self-awareness:** • provides opportunities for self-assessment of their skills and progress in applying these concepts to manipulate data. • helps students to recognise their emotions and attitudes towards the topic, and support their self-confidence and self-efficacy. **Self-management:** • guides students in setting goals and planning their work • fosters resilience and perseverance by supporting students in managing challenges and setbacks they may encounter during the learning process. **Social awareness:** • promotes collaborative learning by assigning group projects or activities to learners • encourages students to share their knowledge and expertise with their peers, creating a supportive learning community.	**Level 1 Recall** Level 2 Skills of conceptual understanding: Level 3 Strategic reasoning: Level 4 Extended critical thinking and reasoning:

	Relationship skills: • promotes teamwork and collaboration by encouraging students to work together to solve complex problems and share their insights and solutions. • emphasises the value of giving and receiving constructive feedback. **Responsible decision-making:** • encourages learners to make informed decisions. • encourages critical thinking and reflection.		
	1.2.1.LI.2		1.1.1.AS.2
	Differentiate between the types of Data Structures **Problem-Based Learning:** Engage in brainstorming activities to explore and discuss the different types of data structures, highlighting their characteristics and advantages in managing and processing data effectively.		**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Notepad or exercise book • Pen • Smartphones • Laptops	• Desktop computers • Tablets • TV and Radio • Open Educational Resources (including YouTube, MOOCs - Udemy/Coursera, Khan Academy, and TESSA)	• The iBox/iCampus (CENDLOS) • Productivity tools ix. Subject-based application software • Instructional Laboratories (with multimedia equipment and smartboards) • Maintenance and repair workshops

Subject **COMPUTING**
Strand **2. COMPUTATIONAL THINKING (PROGRAMMING LOGIC)**
Sub-Strand **2. APP DEVELOPMENT**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
1.2.2.LO.1		
Apply Algorithms in various real-life and programming situations or problems	**Critical Thinking and Problem-Solving**: Learners exhibit the ability to analyse, evaluate, and solve complex problems using logical and creative thinking in applying Algorithms in various real-life and programming situations or problems **Creativity and Innovation**: Learners exhibit the capacity to generate original ideas, think outside the box, and approach tasks with a fresh perspective with respect to the Application of Computer Architecture concepts **Digital Literacy**: The competence to use digital technologies, navigate online information, and apply digital tools effectively and responsibly.	**GESI:** Promoting inclusivity in the classroom by encouraging every learner to actively participate in lessons, cross-sharing of ideas and thoughts between and among groups and individuals ensures; • respecting individuals of varying beliefs, religions and cultures • being sensitive to the inter-relatedness of the various spheres of life, groups and individuals • being aware of personal biases and stereotypes • embracing diversity and practise inclusion **SEL:** Learners acquire and employ knowledge, skills, and attitudes in order to: • foster the development of a resilient and optimistic self-perception, nurturing the cultivation of healthy identities. • skillfully navigate and regulate their emotions, thereby promoting overall emotional well-being. • establish and achieve personal and collaborative goals, fostering personal

		growth and collective accomplishments. • cultivate empathy for others, actively demonstrating understanding and compassion. • foster the establishment and maintenance of supportive relationships, promoting a profound sense of belonging. • exercise conscientious and compassionate decision-making, taking into account the well-being of both themselves and others. By integrating these SEL features into the teaching of Algorithms, teachers can create a supportive and inclusive learning environment. This approach promotes learners' emotional well-being, enhances their collaborative and communication skills, and fosters responsible decision-making in applying Algorithms in various real-life and programming situations or problems. **National core values:** • Tolerance • Friendliness • Open-mindedness • Patience • Commitment • Hard work • Integrity

Content Standards	**Learning Indicators and Pedagogical Exemplars with 21st Century and GESI**	**Assessment**
1.2.2.CS.1	1.2.2.LI.1	1.2.1.AS.1
Demonstrate knowledge and understanding of Computational Thinking (Algorithms and Programs)	**Explain and use Algorithms to solve a real-life problem.** **Identify the stages in the programme development cycle:** **Analysis, design, coding, testing** **Collaborative Learning**: • Group discussion on the understanding of Algorithms and relate it to real-time problems. • Project-based learning within a practical session (individual and mixed ability/gender sensitive groups work with no stereotyping) to use algorithms to solve real-time problems using the programme development cycle. **SEL:** When teaching about Algorithms, integrate Social Emotional Learning (SEL) principles to create an engaging and supportive learning experience. Here are some SEL features you can incorporate into this specific topic: **Self-awareness:** • provides opportunities for self-assessment of their skills and progress in applying these concepts to manipulate data. • helps students recognise their emotions and attitudes towards the topic, supporting their self-confidence and self-efficacy. **Self-management:** • guides students in setting goals and planning their work • fosters resilience and perseverance by supporting students in managing challenges and setbacks they may encounter during the learning process. **Social awareness:** • promotes collaborative learning by assigning group projects or activities to learners • encourages students to share their knowledge and expertise with their peers, creating a supportive learning community.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning

	Relationship skills: • promotes teamwork and collaboration by encouraging students to work together to solve complex problems and share their insights and solutions. • emphasises the value of giving and receiving constructive feedback **Responsible decision-making:** • encourages learners to make informed decisions. • encourages critical thinking and reflection.		
	1.2.2.LI.2		1.2.1.AS.2
	Implement Algorithms into programmes with the use of flowcharts, pseudocode and programming languages such as Python, HTML, etc. **Explain the steps in planning a programme putting actions in the right order** **Collaborative Learning:** • Use an algorithm to plan a programme (finding the sum of two numbers, the sum of an area of a rectangle, circle, triangle etc.) • Use variables, data types (integers, strings…etc.)		Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Notepad or exercise book • Pen • Smartphones • Laptops	• Desktop computers • Tablets • TV and Radio • Open Educational Resources (including YouTube, MOOCs-Udemy/Coursera, Khan Academy, and TESSA)	• The iBox/iCampus (CENDLOS) • Productivity tools ix. Subject-based application software • Instructional Laboratories (with multimedia equipment and smartboards) • Maintenance and repair workshops

Subject **COMPUTING**
Strand **2. PROCEDURAL PROGRAMMING (COMPUTATIONAL THINKING)**
Sub-Strand **3. WEB TECHNOLOGIES**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
1.2.3.LO.1		
Explain the basic principles of web design and identify the modern technologies used in web design.	**Communication**: The skill to effectively express ideas and information through various mediums and engage in active listening by peer-to-peer presentations, etc., in explaining the basic principles of web design **Collaboration and Teamwork**: The ability to work effectively in diverse groups, value different perspectives, and contribute collectively towards shared goals**.** **Digital Literacy**: The competence to use digital technologies, navigate online information, and apply digital tools effectively and responsibly.	**GESI:** As all learners are supported in an inclusive environment and given equal opportunities they will; • appreciate, value, and embrace diversity as they are made to work in groups. • learn to amicably resolve conflicts and embrace differing opinions. • develop emotional intelligence as their submissions are critiqued by others. • embrace tolerance and empathy among each other. • learn to resolve conflicts and embrace differing opinions amicably. • develop emotional intelligence as others critique their submissions. **SEL:** Learners acquire and apply knowledge, skills, and attitudes to: • foster the development of a strong and positive self-image, nurturing the cultivation of healthy identities. • effectively manage their emotions, promoting emotional well-being and balance. • set and accomplish personal and collective goals, fostering growth and success.

		• cultivate empathy for others, exemplifying understanding and compassion. • establish and sustain supportive relationships, nurturing a sense of belonging and community. • make responsible and compassionate decisions, prioritising the welfare of themselves and others. By integrating these SEL features into teaching the basic principles of web design, teachers can create a supportive and inclusive learning environment. This approach promotes learners' emotional well-being, enhances their collaborative and communication skills, and fosters responsible decision-making in explaining the basic principles of web design and describes the modern technologies used in web design principles. **National core values:** • Tolerance • Integrity • Accountability • Humility • Assertiveness • Patriotism

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
1.2.3.CS.1	1.2.3.LI.1	1.2.3AS.1
Demonstrate knowledge and understanding of Web Development	**Identify and describe the key components of a Web page, including headings, menus, links, text, images, and other relevant elements.** **Group Work/Talk for Learning:** • Identifying components of a web page. • Utilise think-pair-share or similar collaborative approaches to facilitate discussions among learners and identify the various components found in a web page. Encourage learners to list and describe the components they identify. **SEL:** When teaching about Web Development, you can integrate Social Emotional Learning (SEL) principles to create an engaging and supportive learning experience. Here are some SEL features you can incorporate into this specific topic: **Self-awareness:** • provides opportunities for self-assessment of their skills and progress in applying these concepts to manipulate data. • helps students recognise their emotions and attitudes towards the topic, supporting their self-confidence and self-efficacy. **Self-management:** • guides students in setting goals and planning their work • fosters resilience and perseverance by supporting students in managing challenges and setbacks they may encounter during the learning process. **Social awareness:** • promotes collaborative learning by assigning group projects or activities to learners • encourages students to share their knowledge and expertise with their peers, creating a supportive learning community.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning

	Relationship skills: • promotes teamwork and collaboration by encouraging students to work together to solve complex problems and share their insights and solutions. • emphasises the value of giving and receiving constructive feedback **Responsible decision-making:** • encourages learners to make informed decisions. • encourages critical thinking and reflection.		
	1.2.3.LI.2		1.2.3AS.2
	Draw and explain 2 Web Outline plans showing the wireframes • Brainstorming on what is a website map, and web outline plan using the wireframes. • Engage learners in a brainstorming session to explore the concept of website mapping and the creation of web outline plans using wireframes. • Encourage learners to draw and explain two web outline plans, demonstrating their understanding of wireframes as a visual representation of a website's structure.		Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Notepad or exercise book • Pen • Smartphones • Laptops • Desktop computers	• Tablets • TV and Radio • Open Educational Resources (including YouTube, MOOCs - Udemy/Coursera, Khan Academy, and TESSA) • The iBox/iCampus (CENDLOS)	• Productivity tools ix. Subject-based application software • Instructional laboratories (with multimedia equipment and smartboards) • Maintenance and repair workshops

YEAR TWO

Subject COMPUTING
Strand 1. COMPUTER ARCHITECTURE & ORGANISATION
Sub-Strand 1. DATA STORAGE AND MANIPULATION

Learning Outcomes	21st Century Skills and Competencies	GESI[3], SEL[4] and Shared National Values
2.1.1.LO.1		
Develop knowledge and skills in implementing and applying programme execution and logic instructions effectively.	**Critical Thinking and Problem-Solving**: Learners exhibit the ability to analyse, evaluate, and solve complex problems using logical and creative thinking in the application of programme execution and logic instructions **Digital Literacy**: The competence to use digital technologies, navigate online information, and apply digital tools effectively and responsibly.	**GESI:** Ensuring all learners in class irrespective of the diversity in ability, socio-cultural backgrounds, and gender and soliciting contributions from all learners ensures; • respect for individuals of varying beliefs, religions, backgrounds, and cultures. • knowledge of themselves and others' peculiarities, strengths, and weaknesses. • tolerance for diversity and respect for all. **SEL:** Learners adopt and utilise knowledge, skills, and attitudes to: • cultivate a resilient and positive sense of self, fostering the growth of healthy identities. • skillfully manage their emotions, promoting overall emotional well-being and harmony. • set and achieve personal and collective goals, fostering continuous growth and accomplishment. • develop empathy for others, actively demonstrating understanding and compassion.

[3] Gender Equality and Social Inclusion

[4] Socio-Emotional Learning

		• establish and maintain supportive relationships, nurturing a sense of belonging and connectedness. • exercise conscientious and compassionate decision-making, considering the well-being of themselves and others in their choices. By integrating these SEL features into the teaching of programme execution and logic instructions, teachers can create a supportive and inclusive learning environment. This approach promotes learners' emotional well-being, enhances their collaborative and communication skills, and fosters responsible decision-making in using knowledge and skills in implementations and applications of programme execution and logic instructions. **National core values:** • Tolerance • Friendliness • Open-mindedness • Patience • Commitment • Hard work

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 Programme Execution and Logic Instructions	**Determine critical points of Logic Operations and apply them to solve problems efficiently.** **Group Work/Collaborative Learning: Identifying and discussing Mass Storage Media:** Engage in interactive presentations, video analysis, and debates by dividing the class into mixed-ability groups. Task the groups with identifying, classifying, and discussing three different Mass Storage Media. Ensure the group promotes inclusivity and equity, considering the needs of individuals with visual impairment, dyslexia, dysgraphia, and other diverse learning needs. **SEL:** When teaching students about Logic Operations, you can integrate Social Emotional Learning (SEL) principles to create an engaging and supportive learning experience. Here are some SEL features you can incorporate into this specific topic: **Self-awareness:** • provides opportunities for self-assessment of their skills and progress in applying these concepts to manipulate data. • helps students to recognise their emotions and attitudes towards the topic, supporting their self-confidence and self-efficacy. **Self-management:** • guides students in setting goals and planning their work • fosters resilience and perseverance by supporting students in managing challenges and setbacks they may encounter during the learning process. **Social awareness:** • promotes collaborative learning by assigning group projects or activities to learners • encourages students to share their knowledge and expertise with their peers, creating a supportive learning community.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning

	Relationship skills: • promotes teamwork and collaboration by encouraging students to work together to solve complex problems and share their insights and solutions. • emphasises the value of giving and receiving constructive feedback **Responsible decision-making:** • encourages learners to make informed decisions. • encourages critical thinking and reflection	
	2.1.1.LI.2	2.1.1.AS.2
	Apply the Concepts of Boolean Expressions to simplify complex circuits **Group Work/Collaborative Learning:** • Utilise interactive presentations, video analysis, and debates by dividing the class into mixed-ability groups. Task the groups with applying the Concepts of Boolean Expressions to simplify complex circuits. Ensure the groupings foster inclusivity and equity by considering the needs of individuals with visual impairment, dyslexia, dysgraphia, and other diverse learning needs.	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
	Discuss 3 major Arithmetic Operations and apply them taking into consideration their various functions **Group Work/Collaborative Learning:** • Engage in interactive presentations, video analysis, and debates by dividing the class into mixed-ability groups. Task the groups with discussing the three major Arithmetic Operations and applying them, considering their various functions. • Similar to previous indicators, ensure the group division promotes inclusivity and equity, considering the needs of individuals with visual impairment, dyslexia, dysgraphia, and other diverse learning needs.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning

Teaching and Learning Resources	• Notepad or exercise book • Pen • Smartphones • Laptops	• Desktop computers • Tablets • TV and Radio	• The iBox/iCampus (CENDLOS) • Productivity tools ix. Subject-based application software

		• Open Educational Resources (including YouTube, MOOCs - Udemy/Coursera, Khan Academy, and TESSA)	• Instructional Laboratories (with multimedia equipment and smartboards) • Maintenance and repair workshops

Subject **COMPUTING**
Strand **1. COMPUTER ARCHITECTURE & ORGANISATION**
Sub-Strand **2. COMPUTER HARDWARE AND SOFTWARE**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
2.1.2.LO.1		
Apply acquired skills and knowledge to explain the functioning of input and output devices in relation to barcodes and QR codes, as well as the functionality of an Operating System.	**Critical Thinking and Problem-Solving**: Learners exhibit the ability to analyse, evaluate, and solve complex problems using logical and creative thinking in explaining how input and output devices function with respect to bar-codes and QR codes and the functionality of an Operating System **Creativity and Innovation**: Learners exhibit the capacity to generate original ideas, think outside the box, and approach tasks with a fresh perspective with respect to the Application of Computer Architecture. **Communication**: The skill to effectively express ideas and information through various mediums and engage in active listening by peer-to-peer, presentation etc. **Collaboration and Teamwork**: The ability to work effectively in diverse groups, value different perspectives, and contribute collectively towards shared goals. **Digital Literacy**: The competence to use digital technologies, navigate online information, and apply digital tools effectively and responsibly. **Flexibility and Adaptability:** The willingness to embrace change, be open to new ideas, and adjust to evolving circumstances.	**GESI:** Giving equal opportunities to all learners irrespective of their background and soliciting views from all learners ensures; • respect for individuals of varying beliefs, religions, backgrounds and cultures. • sensitivity to the inter-relatedness of the various spheres of life, groups and individuals. • awareness of personal biases, peculiarities and stereotypes. • tolerance for diversity **SEL:** Learners acquire and apply knowledge, skills, and attitudes to: • cultivate a robust and positive self-concept, nurturing the development of healthy identities. • effectively regulate and navigate their emotions, promoting emotional well-being and stability. • set and attain personal and collective objectives, fostering growth and fulfillment.

		• foster empathy for others, demonstrating understanding and compassion in their interactions. • establish and sustain supportive connections, fostering a sense of belonging and inclusion. • make responsible and empathetic decisions, considering the welfare and needs of both themselves and others. By integrating these SEL features into teaching on input and output devices, teachers can create a supportive and inclusive learning environment. This approach promotes students' emotional well-being, enhances their collaborative and communication skills, and fosters responsible decision-making in using the knowledge acquired to explain how input and output devices function with respect to bar-codes and QR codes and the functionality of an Operating System. **National core values:** • Tolerance • Friendliness • Open-mindedness • Patience • Commitment • Hard work • Honesty • Truthfulness.

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 of components of Computer Hardware and types of Software	**Demonstrate the creation and utilisation of barcodes and QR codes using various input and output devices, such as monitors, system unit, processors, motherboards, hard disks, clock, power unit, network interface cards, scanners, digital cameras, keyboards, microphones, mice, touchscreen sensors for control and monitoring.** **Problem-Based Learning Approach**: Organise learners into mixed-ability groups and task them with brainstorming on the creation and use of barcodes and QR codes, using the listed devices in the learning indicator. Allow them to share their thoughts with the whole class while fostering an environment that tolerates different viewpoints. **SEL:** When teaching students about components of Computer Hardware and types of Software, you can integrate Social Emotional Learning (SEL) principles to create an engaging and supportive learning experience. Here are some SEL features you can incorporate into this specific topic: **Self-awareness:** • provides opportunities for self-assessment of their skills and progress in applying these concepts to manipulate data. • helps students to recognise their emotions and attitudes towards the topic, supporting their self-confidence and self-efficacy. **Self-management:** • guides students in setting goals and planning their work. • fosters resilience and perseverance by supporting students in managing challenges and setbacks they may encounter during the learning process. **Social awareness:** • promotes collaborative learning by assigning group projects or activities to learners • encourages students to share their knowledge and expertise with their peers, creating a supportive learning community.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning

	Relationship skills: • promotes teamwork and collaboration by encouraging students to work together to solve complex problems and share their insights and solutions. • emphasises the value of giving and receiving constructive feedback. **Responsible decision-making:** • encourages learners to make informed decisions. • encourages critical thinking and reflection.	
	2.1.2.LI.2	2.1.2.AS.2
	Explain the types of Software and their functions. **Using Problem-Based Learning Approach**: Task learners to identify and explain the types of software and state their functions. **Using the Problem-Based Learning Approach:** Group learners according to their mixed abilities and task them with downloading and installing simple everyday software, such as antivirus programs, games, media players, etc.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Notepad or exercise book • Pen • Smartphones • Laptops • Desktop computers • Tablets	• TV and Radio • Open Educational Resources (including YouTube, MOOCs - Udemy/Coursera, Khan Academy, and TESSA) • The iBox/iCampus (CENDLOS) • Productivity tools ix. Subject-based application software • Instructional Laboratories (with multimedia equipment and smartboards) • Maintenance and repair workshops

Subject COMPUTING
Strand 1. COMPUTER ARCHITECTURE & ORGANISATION
Sub-Strand 3. DATA COMMUNICATION AND NETWORK SYSTEMS

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
2.1.3.LO.1		
Apply skills and knowledge to design and demonstrate simple Network Topologies.	**Critical Thinking and Problem-Solving**: Learners exhibit the ability to analyse, evaluate, and solve complex problems using logical and creative thinking in designing simple Network Topology. **Creativity and Innovation**: Learners exhibit the capacity to generate original ideas, think outside the box, and approach tasks with a fresh perspective with respect to the Application of Computer Architecture concepts. **Collaboration and Teamwork**: The ability to work effectively in diverse groups, value different perspectives, and contribute collectively towards shared goals. **Digital Literacy**: The competence to use digital technologies, navigate online information, and apply digital tools effectively and responsibly. **Flexibility and Adaptability**: The willingness to embrace change, be open to new ideas, and adjust to evolving circumstances.	**GESI:** Giving equal opportunities to all learners irrespective of their background and soliciting views from all learners ensures; • respect for individuals of varying beliefs, religions, backgrounds and cultures. • sensitivity to the inter-relatedness of the various spheres of life, groups and individuals • awareness of personal biases, peculiarities and stereotypes • tolerance for diversity **SEL:** Learners acquire and employ knowledge, skills, and attitudes to: • foster a strong and confident self-image, nurturing the cultivation of healthy identities. • skilfully manage their emotions, promoting emotional well-being and resilience. • set and achieve personal and collective goals, fostering growth and accomplishment. • cultivate empathy for others, exemplifying understanding and compassion in their interactions.

		• establish and maintain supportive relationships, fostering a sense of belonging and camaraderie. • make conscientious and compassionate decisions, considering the well-being and welfare of themselves and others. **National core values:** • Tolerance • Friendliness • Open-mindedness • Patience • Commitment • Hard work • Honesty • Truthfulness

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 Components of a Network	**Design and explain 2 Network Systems** **Interactive student-centred teaching and learning: Explaining network topologies:** Utilise interactive teaching methods to engage students in explaining various network topologies such as Star, Ring, Bus, and Mesh. Foster student participation and facilitate group discussions to differentiate the concepts of LAN, MAN, WAN, and CAN. **SEL:** When teaching about the Components of a Network, teachers can integrate Social Emotional Learning (SEL) principles to create an engaging and supportive learning experience. Here are some SEL features you can incorporate into this specific topic: **Self-awareness:** • provides opportunities for self-assessment of their skills and progress in applying these concepts to manipulate data. • helps students to recognise their emotions and attitudes towards the topic, supporting their self-confidence and self-efficacy. **Self-management:** • guides students in setting goals and planning their work • fosters resilience and perseverance by supporting students in managing challenges and setbacks they may encounter during the learning process. **Social awareness:** • promotes collaborative learning by assigning group projects or activities to learners • encourages students to share their knowledge and expertise with their peers, creating a supportive learning community. **Relationship skills:** • promotes teamwork and collaboration by encouraging students to work together to solve complex problems and share their insights and solutions. • emphasises the value of giving and receiving constructive feedback	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**

	Responsible decision-making: • encourages learners to make informed decisions. • encourages critical thinking and reflection	
	2.1.3.LI.2	2.1.3.AS.2
	Demonstrate how the system can connect to the Internet. **Talk for Learning Approach: Connecting systems to the Internet:** Divide learners into small groups to discuss and demonstrate how systems can be connected to the Internet. Encourage other groups to observe and provide objective feedback.	**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
	Discuss and compare at least three network topologies. **Talk for Learning Approach: Contrasting Network Topologies:** Use question-and-answer sessions to facilitate discussions among learners on the characteristics of three network topologies. Invite individual learners to demonstrate how to connect devices like hubs, routers, bridges, and switches, while others provide comments and feedback.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Notepad or exercise book • Pen • Smartphones • Laptops • Desktop computers • Tablets	• TV and Radio • Open Educational Resources (including YouTube, MOOCs-Udemy/Coursera, Khan Academy, and TESSA) • The iBox/iCampus (CENDLOS) • Productivity tools ix. Subject-based application software • Instructional Laboratories (with multimedia equipment and smartboards) • Maintenance and repair workshops

Subject **COMPUTING**
Strand **2. COMPUTATIONAL THINKING (PROGRAMMING LOGIC)**
Sub-Strand **1. ALGORITHM AND DATA STRUCTURE**

Learning Outcomes	**21st Century Skills and Competencies**	**GESI, SEL and Shared National Values**
2.2.1.LO.1		
Apply skills in data storage processes to effectively manage and utilise data.	**Critical Thinking and Problem-Solving**: Learners exhibit the ability to analyse, evaluate, and solve complex problems using logical and creative thinking in data storage processes. **Creativity and Innovation**: Learners exhibit the capacity to generate original ideas, think outside the box, and approach tasks with a fresh perspective with respect to the Application of Computer Architecture concepts **Collaboration and Teamwork**: The ability to work effectively in diverse groups, value different perspectives, and contribute collectively towards shared goals**.** **Digital Literacy**: The competence to use digital technologies, navigate online information, and apply digital tools effectively and responsibly. **Flexibility and Adaptability**: The willingness to embrace change, be open to new ideas, and adjust to evolving circumstances.	**GESI:** Giving equal opportunities to all learners irrespective of their background and soliciting views from all learners ensures; • respect for individuals of varying beliefs, religions, backgrounds and cultures • sensitivity to the inter-relatedness of the various spheres of life, groups and individuals • awareness of personal biases, peculiarities and stereotypes • tolerance for diversity **SEL:** Learners acquire and utilise knowledge, skills, and attitudes to: • develop a positive and authentic sense of self, nurturing the cultivation of healthy identities. • effectively regulate and navigate their emotions, promoting emotional well-being and self-awareness. • set and accomplish personal and collective goals, fostering growth and success.

		• cultivate empathy for others, demonstrating understanding and compassion in their interactions. • establish and sustain meaningful relationships, fostering a sense of connection and belonging. • make thoughtful and ethical decisions, considering the well-being and welfare of themselves and others. By integrating these SEL features into the teaching on data storage processes, teachers can create a supportive and inclusive learning environment. This approach promotes students' emotional well-being, enhances their collaborative and communication skills, and fosters responsible decision-making in developing and using skills in data storage processes. **National core values:** • Tolerance • Friendliness • Open-mindedness • Patience • Commitment • Hard work • Honesty • Truthfulness

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
2.2.1.CS.1	2.2.1.LI.1	2.2.1AS.1
Demonstrate knowledge and understanding of Data Storage	**State and describe the functions of the Main Memory.** **Problem-Based Learning:** • In mixed-ability groups, learners must state and describe the steps to resolve a slow computer caused by Main Memory overload. • They must also collaboratively brainstorm and discuss strategies for managing Main Memory to improve computer performance. **SEL:** When teaching about Data Storage, usage, and the function of Internet Service Providers (ISPs), you can integrate Social Emotional Learning (SEL) principles to create an engaging and supportive learning experience. Here are some SEL features you can incorporate into this specific topic: **Self-awareness:** • provides opportunities for self-assessment of their skills and progress in applying these concepts to manipulate data. • helps students to recognise their emotions and attitudes towards the topic, supporting their self-confidence and self-efficacy. **Self-management:** • guides students in setting goals and planning their work • fosters resilience and perseverance by supporting students in managing challenges and setbacks they may encounter during the learning process. **Social awareness:** • promotes collaborative learning by assigning group projects or activities to learners • encourages students to share their knowledge and expertise with their peers, creating a supportive learning community.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning

	Relationship skills: • promotes teamwork and collaboration by encouraging students to work together to solve complex problems and share their insights and solutions. • emphasises the value of giving and receiving constructive feedback . **Responsible decision-making:** • encourages learners to make informed decisions. • encourages critical thinking and reflection.	
	2.2.1.LI.2	2.2.1AS.2
	Explain real-life applications of Data Structures **Problem-Based Learning:** • In mixed-ability groups, learners must engage in discussions about Data Structures and their practical applications in solving specific problems. • They must also explore and analyse how different data structures can be utilised to address specific challenges in various fields.	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Notepad or exercise book • Pen • Smartphones • Laptops • Desktop computers • Tablets • TV and Radio • Open Educational Resources (including YouTube, MOOCs - Udemy/Coursera, Khan Academy, and TESSA) • The iBox/iCampus (CENDLOS)	• Productivity tools ix. Subject-based application software • Instructional laboratories (with multimedia equipment and smartboards) • Maintenance and repair workshops • Presentation and demonstration • Enquiry on critical infrastructure security • Application security • Network security. • Cloud security, Internet of Things (IoT) security

Subject **COMPUTING**
Strand **2. COMPUTATIONAL THINKING (PROGRAMMING LOGIC)**
Sub-Strand **2. APP DEVELOPMENT**

Learning Outcomes	**21st Century Skills and Competencies**	**GESI, SEL and Shared National Values**
2.2.2.LO.1		
Demonstrate an understanding of fundamental concepts in text-based programming and the programming process, and apply acquired skills to create new functions.	**Critical Thinking and Problem Solving**: Learners exhibit the ability to analyse, evaluate, and solve complex problems using logical and creative thinking in text-based programming, programming process **Creativity and Innovation**: Learners exhibit the capacity to generate original ideas, think outside the box, and approach tasks with a fresh perspective with respect to the Application of computer Architecture concepts **Communication**: The skill to effectively express ideas and information through various mediums and engage in active listening by peer-to-peer, presentation etc. **Collaboration and Teamwork**: The ability to work effectively in diverse groups, value different perspectives, and contribute collectively towards shared goals. **Digital Literacy**: The competence to use digital technologies, navigate online information, and apply digital tools effectively and responsibly. **Flexibility and Adaptability**: The willingness to embrace change, be open to new ideas, and adjust to evolving circumstances.	**GESI:** Using mixed-ability and mixed-gender pairings, special attention given to the catch-up, regular, gifted and talented learners leads to; • respecting individuals of varying abilities, beliefs, religions and cultures. • being sensitive to the inter-relatedness of the various spheres of life, groups and individuals. • being aware of personal biases and stereotypes. • Embracing diversity and practising inclusion **SEL:** Learners acquire and apply knowledge, skills, and attitudes to: • foster a resilient and empowered self-perception, nurturing the development of healthy identities. • skilfully manage and navigate their emotions, promoting emotional well-being and self-care. • set and achieve personal and collective aspirations, fostering growth and attainment.

		• cultivate empathy and understanding for others, exemplifying compassion and kindness. • establish and nurture supportive connections, fostering a sense of community and inclusivity. • make responsible and conscientious decisions, prioritising the well-being of themselves and others in their choices. By integrating these SEL features into the teaching of text-based programming, teachers can create a supportive and inclusive learning environment. This approach promotes students' emotional well-being, enhances their collaborative and communication skills, and fosters responsible decision-making in explaining the necessary concepts of text-based programming, the programming process and using the skills acquired to write new functions. **National core values**: • Integrity • Tolerance • Open-mindedness • Patience • Integrity • Hard work

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
2.2.2.CS.1	2.2.2.LI.1	2.2.2.AS.1
Demonstrate knowledge and understanding of Computational Thinking (Programming)	**Utilise a programming language to develop a program, such as a simple calculator.** **Problem-Based Learning Approach:** • Explain the concept of an expert system and its applications. • Identify and describe the essential steps involved in planning a programme. • Explain the concept of algorithms by drawing parallels to procedural instructions, including the selection of necessary actions and arranging them in the correct sequence. **SEL:** When teaching about Computational Thinking, teachers can integrate Social Emotional Learning (SEL) principles to create an engaging and supportive learning experience. Here are some SEL features you can incorporate into this specific topic: **Self-awareness:** • provides opportunities for self-assessment of their skills and progress in applying these concepts to manipulate data. • helps students to recognise their emotions and attitudes towards the topic, supporting their self-confidence and self-efficacy. **Self-management:** • guides students in setting goals and planning their work. • fosters resilience and perseverance by supporting students in managing challenges and setbacks they may encounter during the learning process. **Social awareness:** • promotes collaborative learning by assigning group projects or activities to learners. • encourages students to share their knowledge and expertise with their peers, creating a supportive learning community.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning

	Relationship skills: • promotes teamwork and collaboration by encouraging students to work together to solve complex problems and share their insights and solutions. • emphasises the value of giving and receiving constructive feedback **Responsible decision-making:** • encourages learners to make informed decisions. • encourages critical thinking and reflection.	
	2.2.2.LI.2	2.2.2.AS.2
	Utilise simulation tools in Machine Learning to train a computer to perform specific actions or sets of actions. **Problem-Based Learning Approach:** • Apply algorithms to design programmes for various tasks, such as calculating the sum of two numbers or computing the area of geometric shapes (rectangle, circle, triangle, etc.). Demonstrate the use of variables and different data types (integers, strings, etc.) in programming.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Notepad or exercise book • Pen • Smartphones • Laptops • Productivity tools ix. Subject-based application software • Desktop computers	• Tablets • TV and radio • Open Educational Resources (including YouTube, MOOCs - Udemy/Coursera, Khan Academy, and TESSA) • The iBox/iCampus (CENDLOS) • Instructional laboratories (with multimedia equipment and smartboards)

Subject **COMPUTING**
Strand **2. COMPUTATIONAL THINKING (PROGRAMMING LOGIC)**
Sub-Strand **3. WEB TECHNOLOGIES AND DATABASES**

Learning Outcomes	**21st Century Skills and Competencies**	**GESI, SEL and Shared National Values**
2.2.3.LO.1		
Apply acquired skills and knowledge to design and develop simple web pages	**Critical Thinking and Problem-Solving**: Learners exhibit the ability to analyse, evaluate, and solve complex problems using logical and creative thinking in designing simple web pages **Creativity and Innovation**: Learners exhibit the capacity to generate original ideas, think outside the box, and approach tasks with a fresh perspective with respect to the Application of Computer Architecture concepts **Collaboration and Teamwork**: The ability to work effectively in diverse groups, value different perspectives, and contribute collectively towards shared goals. **Digital Literacy**: The competence to use digital technologies, navigate online information, and apply digital tools effectively and responsibly. **Flexibility and Adaptability**: The willingness to embrace change, be open to new ideas, and adjust to evolving circumstances.	**GESI:** As all learners are supported in an inclusive environment and given equal opportunities they will; • appreciate, value, and embrace diversity as they are made to work in groups. • learn to amicably resolve conflicts and embrace differing opinions. • embrace tolerance and empathy among each other. • learn to resolve conflicts and embrace differing opinions amicably. **SEL:** Learners acquire and employ knowledge, skills, and attitudes to: • cultivate a confident and positive self-image, nurturing the growth of healthy identities. • effectively regulate and manage their emotions, promoting emotional well-being and resilience. • set and accomplish personal and collective goals, fostering continuous growth and achievement.

		• foster empathy and understanding for others, demonstrating compassion and consideration. • establish and sustain supportive relationships, fostering a sense of belonging and connection. • make informed and compassionate decisions, considering the well-being and welfare of themselves and others. By integrating these SEL features into teaching designing web pages, teachers can create a supportive and inclusive learning environment. This approach promotes students' emotional well-being, enhances their collaborative and communication skills, and fosters responsible decision-making in using knowledge acquired to design simple web pages. **National core values:** • Tolerance • Integrity • Accountability • Humility • Assertiveness • Patriotism

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
2.2.3.CS.1	2.2.3.LI.1	2.2.3.AS.1
Demonstrate knowledge and understanding of Web Development and Databases	**Demonstrate the use of web page editors and design elements, including sections, text, images, GUI/UI/UX, and multimedia integration.** **Project-Based Learning Approach:** • Engage in whole-class discussions to explore different web page editors and their features, such as Notepad, Atom, Visual Studio Code, Notepad++, etc. • Conduct practical sessions with individuals and in mixed-ability/gender-sensitive groups, utilising text editors' features. • Employ interactive multimedia presentations and video analysis to facilitate discussions and demonstrate techniques for creating web pages using various editors. Ensure inclusivity and equity by considering different learners' abilities and providing appropriate input devices for data analysis. **SEL:** When teaching about Web development and databases, usage, and the function of Internet Service Providers (ISPs), teachers can integrate Social Emotional Learning (SEL) principles to create an engaging and supportive learning experience. Here are some SEL features you can incorporate into this specific topic: **Self-awareness:** • provides opportunities for self-assessment of their skills and progress in applying these concepts to manipulate data. • helps students to recognise their emotions and attitudes towards the topic, supporting their self-confidence and self-efficacy. **Self-management:** • guides students in setting goals and planning their work • fosters resilience and perseverance by supporting students in managing challenges and setbacks they may encounter during the learning process. **Social awareness:** • promotes collaborative learning by assigning group projects or activities to learners	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning

	• encourages students to share their knowledge and expertise with their peers, creating a supportive learning community. **Relationship skills:** • promotes teamwork and collaboration by encouraging students to work together to solve complex problems and share their insights and solutions. • emphasises the value of giving and receiving constructive feedback. **Responsible decision-making:** • encourages learners to make informed decisions. • encourages critical thinking and reflection.	
	2.2.3.LI.2	2.2.3.AS.2
	Design an e-commerce web page for a selected company or organisation. **Project- Based learning**: • Participate in practical sessions, both individually and in mixed-ability/gender-sensitive group work, to create web pages using available tools. • Utilise interactive multimedia presentations and video analysis to explore concepts and techniques specific to e-commerce web page design.	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic **reasoning** **Level 4 Extended critical thinking and reasoning**
	2.2.3.LI.3	2.2.3.AS.3
	Create a relational database model of a database. **Project-Based Learning Approach:** • Engage in whole-class discussions to explore databases • Conduct practical sessions in individual and mixed-ability/gender-sensitive group work. • Employ interactive multimedia presentations and video analysis to facilitate discussions and demonstrate techniques for creating a relational database model	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Notepad or exercise book • Pen • Smartphones • Laptops • Desktop computers	• TV and Radio • Open Educational Resources (including YouTube, MOOCs - Udemy/Coursera, Khan Academy, and TESSA) • The iBox/iCampus (CENDLOS)

	• Tablets	• Productivity tools ix. Subject-based application software • Instructional Laboratories (with multimedia equipment and smartboards) • Maintenance and repair workshops

YEAR THREE

Subject COMPUTING
Strand 1. COMPUTER ARCHITECTURE & ORGANISATION
Sub-Strand 1. DATA STORAGE AND MANIPULATION

Learning Outcomes	21st Century Skills and Competencies	GESI[5], SEL[6] and Shared National Values
3.1.1.LO.1		
Apply acquired knowledge and skills of programme execution, logic instructions, and arithmetic operations in the CPU to solve real-life problems.	**Critical Thinking and Problem-Solving:** Learners exhibit the ability to analyse, evaluate, and solve complex problems using logical and creative thinking in designing implementations and applications of programme execution and logic instructions. **Creativity and Innovation**: Learners exhibit the capacity to generate original ideas, think outside the box, and approach tasks with a fresh perspective with respect to the Application of Computer Architecture concepts **Digital Literacy:** The competence to use digital technologies, navigate online information, and apply digital tools effectively and responsibly.	**GESI:** Ensuring all learners in class irrespective of the diversity in ability, socio-cultural backgrounds, and gender and soliciting contributions from all learners ensures; • respect for individuals of varying beliefs, religions, backgrounds and cultures. • knowledge of themselves and others' peculiarities, strengths and weaknesses. • tolerance for diversity and respect for all. **SEL:** Learners acquire and apply knowledge, skills, and attitudes to: • develop a strong and authentic sense of self, nurturing the cultivation of healthy identities. • effectively navigate and regulate their emotions, promoting emotional well-being and self-awareness. • set and attain personal and collective goals, fostering growth and accomplishment. • cultivate empathy and compassion for others, demonstrating understanding and kindness.

[5] Gender Equality and Social Inclusion

[6] Socio-Emotional Learning

		• establish and foster supportive relationships, promoting a sense of belonging and connectedness. • make conscientious and considerate decisions, taking into account the well-being of themselves and others. By integrating these SEL features into the teaching programme execution and logic instructions, teachers can create a supportive and inclusive learning environment. This approach promotes students' emotional well-being, enhances their collaborative and communication skills, and fosters responsible decision-making in developing knowledge and skills in designing implementations and applications of program execution and logic instructions. **National core values:** • Tolerance, • Friendliness, • Open-mindedness • Patience • Commitment • Hard work

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 Programme Execution and Logic Instruction	**Determine and apply critical points of Logic Operations to solve a problem** **Group Work/Collaborative Learning:** • Organise interactive presentations, video analysis, and debates. • Divide the class into mixed-ability groups and task them with designing and applying programme execution and logic instructions to solve an identified problem. • Ensure the group division promotes inclusivity and equity, considering the needs of learners with visual impairment, dyslexia, dysgraphia, etc. **SEL:** When teaching students about Programme Execution and Logic Instruction, you can integrate Social Emotional Learning (SEL) principles to create an engaging and supportive learning experience. Here are some SEL features you can incorporate into this specific topic: **Self-awareness:** • provides opportunities for self-assessment of their skills and progress in applying these concepts to manipulate data. • helps students to recognise their emotions and attitudes towards the topic, supporting their self-confidence and self-efficacy. **Self-management:** • guides students in setting goals and planning their work. • fosters resilience and perseverance by supporting students in managing challenges and setbacks they may encounter during the learning process. **Social awareness:** • promotes collaborative learning by assigning group projects or activities to learners. • encourages students to share their knowledge and expertise with their peers, creating a supportive learning community.	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**

	Relationship skills: • promotes teamwork and collaboration by encouraging students to work together to solve complex problems and share their insights and solutions. • emphasises the value of giving and receiving constructive feedback, **Responsible decision-making:** • encourages learners to make informed decisions. • encourages critical thinking and reflection.	
	3.1.1.LI.2	3.1.1.AS.2
	Describe the arithmetic operations in the CPU, specifically Rotation and Shift Operations, and explain their real-life applications. **Group Work/Collaborative Learning Approach:** • Conduct interactive presentations, video analysis, and debates. • Divide the class into mixed-ability groups and ask them to describe Rotation and Shift Operations in their own words. • Foster inclusivity and equity in the group division, accommodating learners with different needs.	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
	Discuss 3 major Arithmetic Operations and apply them taking into consideration their various functions. **Group Work/Collaborative Learning:** • Engage in interactive presentations, video analysis, and debates. • Divide the class into mixed-ability groups and assign them the task of identifying the major problems that Arithmetic Operations can solve and determining how to carry out those operations. • Ensure inclusivity and equity in the groups, considering the needs of learners with visual impairment, dyslexia, dysgraphia, etc.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Notepad or exercise book • Pen • Smartphones • Laptops	• Flash Drive • Desktop computers • Tablets • TV and Radio • The iBox/iCampus (CENDLOS) • Productivity tools ix. Subject-based application software

	• Projector	• Open Educational Resources (including YouTube, MOOCs - Udemy/Coursera, Khan Academy, and TESSA)	• Instructional laboratories (with multimedia equipment and smartboards) • Maintenance and repair workshops

Subject **COMPUTING**
Strand **1. COMPUTER ARCHITECTURE & ORGANISATION**
Sub-Strand **2. COMPUTER HARDWARE AND SOFTWARE**

Learning Outcomes	**21st Century Skills and Competencies**	**GESI, SEL and Shared National Values**
3.1.2.LO.1		
Explain the roles of Operating Systems and Utility Software as components of System Software, demonstrating an understanding of their functions. Perform the installation and management of an operating system, showcasing proficiency in the process.	**Critical Thinking and Problem-Solving**: Learners exhibit the ability to analyse, evaluate, and solve complex problems using logical and creative thinking in describing the roles of Operating Systems and Utility Software **Creativity and Innovation:** Learners exhibit the capacity to generate original ideas, think outside the box, and approach tasks with a fresh perspective with respect to the Application of Computer Architecture concepts **Digital Literacy**: The competence to use digital technologies, navigate online information, and apply digital tools effectively and responsibly.	**GESI:** Promoting inclusivity through the use of various group activities and supporting individual learners to take initiative ensures; • being gender responsive and having the ability to tackle injustice, being aware of personal biases and stereotypes, • embracing diversity and practise inclusion. • being sensitive to the inter-relatedness of the various spheres of life, groups, and individuals, • being aware of personal biases and stereotypes. **SEL:** Learners acquire and utilise knowledge, skills, and attitudes to: • cultivate a resilient and positive self-perception, nurturing the development of healthy identities. • skillfully manage and respond to their emotions, promoting emotional well-being and self-care. • set and achieve personal and collective objectives, fostering growth and success. • cultivate empathy and compassion for others, demonstrating understanding and kindness. • establish and maintain supportive connections, fostering a sense of belonging and community. • make responsible and ethical decisions, considering the well-being and welfare of themselves and others.

		By integrating these SEL features into the teaching of the roles of Operating Systems and Utility Software, teachers create a supportive and inclusive learning environment. This approach promotes learners' emotional well-being, enhances their collaborative and communication skills, and fosters responsible decision-making in using skills and knowledge acquired to describe the roles of Operating Systems and Utility Software as components of System Software **National core values:** • Resourcefulness • Self-discipline • Leadership • Truth • Diversity • Equity • Adaptability • Responsible citizenship • Honesty • Law-abiding • Patriotism • Faithfulness • Loyalty

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 components of Computer Hardware and types of Software	**Demonstrate the roles of Operating Systems and Utility Software as components of System Software.** **Problem-Based Learning:** Ask learners to provide clear and concise explanations of the roles and functions of Operating Systems and Utility Software as a System Software, demonstrating comprehension through examples and illustrations. **SEL:** When teaching students about the components of Computer Hardware and types of Software, teachers can integrate Social Emotional Learning (SEL) principles to create an engaging and supportive learning experience. Here are some SEL features you can incorporate into this specific topic: **Self-awareness:** • provides opportunities for self-assessment of their skills and progress in applying these concepts to manipulate data. helps students to recognise their emotions and attitudes towards the topic, supporting their self-confidence and self-efficacy. **Self-management:** • guides students in setting goals and planning their work. • fosters resilience and perseverance by supporting students in managing challenges and setbacks they may encounter during the learning process. **Social awareness:** • promotes collaborative learning by assigning group projects or activities to learners. • encourages students to share their knowledge and expertise with their peers, creating a supportive learning community. **Relationship skills:** • promotes teamwork and collaboration by encouraging students to work together to solve complex problems and share their insights and solutions.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning

	• emphasises the value of giving and receiving constructive feedback. **Responsible decision-making:** • encourages learners to make informed decisions. • encourages critical thinking and reflection.		
	3.1.2.LI.2		3.1.2.AS.2
	Demonstrate the process of installing and managing an operating system: In mixed-ability groups, let learners brainstorm on the procedures of downloading, installing and managing an operating system.		Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Notepad or exercise book • Pen • Smartphones • Laptops	• Desktop computers • Tablets • TV and Radio • Open Educational Resources (including YouTube, MOOCs - Udemy/Coursera, Khan Academy, and TESSA)	• The iBox/iCampus (CENDLOS) • Productivity tools ix. Subject-based application software • Instructional laboratories (with multimedia equipment and smartboards) • Maintenance and repair workshops

Subject COMPUTING
Strand 1. COMPUTER ARCHITECTURE & ORGANISATION
Sub-Strand 3. DATA COMMUNICATION AND NETWORK SYSTEMS

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
3.1.3.LO.1		
Utilise knowledge of networking topologies to design and configure network systems to meet specific requirements.	**Critical Thinking and Problem-Solving**: • Learners exhibit the ability to analyse, evaluate, and solve complex problems using logical and creative thinking in designing simple network topology • Learners exhibit the capacity to generate original ideas, think outside the box, and approach tasks with a fresh perspective with respect to the Application of Computer Architecture concepts **Digital Literacy**: The competence to use digital technologies, navigate online information, and apply digital tools effectively and responsibly. **Self-Direction and Self-Regulation**: The capability to set goals, manage time effectively, and take ownership of one's learning and behaviour. **Critical Evaluation of Information**: The skill to assess the credibility, accuracy, and relevance of information in a variety of contexts.	**GESI:** Involving all learners in class irrespective of their varying abilities, gender and backgrounds, supporting them to share their views and thoughts ensures; • respect for individuals of varying beliefs, religions, backgrounds and cultures • sensitivity to the inter-relatedness of the various spheres of life, groups and individuals • awareness of personal biases, peculiarities and stereotypes • tolerance for diversity. **SEL:** Learners acquire and apply knowledge, skills, and attitudes to: • foster a confident and empowered self-image, nurturing the development of healthy identities. • effectively navigate and regulate their emotions, promoting emotional well-being and self-awareness. • set and attain personal and collective goals, fostering growth and achievement.

		• cultivate empathy and understanding for others, demonstrating compassion and respect. • establish and sustain supportive relationships, promoting a sense of belonging and collaboration. • make thoughtful and ethical decisions, considering the well-being and welfare of themselves and others. By integrating these SEL features into the teaching of Network Topology, teachers can create a supportive and inclusive learning environment. This approach promotes students' emotional well-being, enhances their collaborative and communication skills, and fosters responsible decision-making in using skills and knowledge to demonstrate and design simple Network Topology. **National core values:** • Tolerance • Friendliness • Open-mindedness • Patience • Commitment • Integrity

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
3.1.3.CS.1	3.1.3.LI.1	3.1.3.AS.1
Demonstrate knowledge and understanding of Components of a Network	**Design and explain two network systems, considering factors such as topology, scalability, and security (password, internet safety, malware awareness, data backups, securing personal devices and good security practices), transmission media and bandwidth.** **Project-Based Learning Approach:** • Engage in whole-class discussions to explore network systems • Conduct practical sessions in individual and mixed-ability/gender-sensitive group work. • Employ interactive multimedia presentations and video analysis to facilitate discussions and demonstrate techniques to consider factors such as topology, scalability and security. **SEL:** When teaching students about the Components of a Network, its usage, and the function of Internet Service Providers (ISPs), teachers can integrate Social Emotional Learning (SEL) principles to create an engaging and supportive learning experience. Here are some SEL features you can incorporate into this specific topic: **Self-awareness:** • provides opportunities for self-assessment of their skills and progress in applying these concepts to manipulate data. • helps students to recognise their emotions and attitudes towards the topic, supporting their self-confidence and self-efficacy. **Self-management:** • guides students in setting goals and planning their work. • fosters resilience and perseverance by supporting students in managing challenges and setbacks they may encounter during the learning process. **Social awareness:** • promotes collaborative learning by assigning group projects or activities to learners. • encourages students to share their knowledge and expertise with their peers, creating a supportive learning community.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning

	Relationship skills: • promotes teamwork and collaboration by encouraging students to work together to solve complex problems and share their insights and solutions. • emphasises the value of giving and receiving constructive feedback. **Responsible decision-making:** • encourages learners to make informed decisions. • encourages critical thinking and reflection	
	3.1.3.LI.2	3.1.3.AS.2
	Demonstrate how the system can connect to the Internet. • Demonstrate the configuration of network devices (e.g., hub, router, switch) to establish connectivity within a network. • Explain the steps involved in connecting a network system to the internet, including considerations for network addressing and security measures. **Project-Based Learning Approach:** • Engage in whole-class discussions to explore network devices. • Conduct practical sessions with individuals and in mixed-ability/gender-sensitive groups. Employ interactive multimedia presentations and video analysis to facilitate discussions and demonstrate techniques to discuss network devices.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
	3.1.3.LI.3	3.1.3.AS.3
	Discuss and compare the characteristics and advantages of at least three network topologies. **Project-Based Learning Approach:** • Engage in whole-class discussions to explore network topologies. • Conduct practical sessions with individuals and in mixed-ability/gender-sensitive group work. Employ interactive multimedia presentations and video analysis to facilitate discussions and demonstrate techniques for network topologies.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning

Teaching and Learning Resources	• Notepad or exercise book • Pen • Smartphones • Laptops • Productivity tools ix. Subject-based application software • Desktop computers • Tablets	• TV and radio • Open Educational Resources (including YouTube, MOOCs - Udemy/Coursera, Khan Academy, and TESSA) • The iBox/iCampus (CENDLOS) • Instructional laboratories (with multimedia equipment and smartboards) • Maintenance and repair workshops

Subject **COMPUTING**
Strand **2. COMPUTATIONAL THINKING (PROGRAMMING LOGIC)**
Sub-Strand **1. ALGORITHM AND DATA STRUCTURE**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
3.2.1.LO.1		
Develop knowledge and skills in data storage technologies and their applications.	**Critical Thinking and Problem-Solving**: Learners exhibit the ability to analyse, evaluate, and solve complex problems using logical and creative thinking in the implementation and applications of data storage. **Creativity and Innovation**: Learners exhibit the capacity to generate original ideas, think outside the box, and approach tasks with a fresh perspective with respect to the Application of Computer Architecture concepts. **Communication**: The skill to effectively express ideas and information through various mediums and engage in active listening by peer-to-peer presentations, etc. **Collaboration and Teamwork**: The ability to work effectively in diverse groups, value different perspectives, and contribute collectively towards shared goals. **Digital Literacy**: The competence to use digital technologies, navigate online information, and apply digital tools effectively and responsibly. **Flexibility and Adaptability**: The willingness to embrace change, be open to new ideas, and adjust to evolving circumstances.	**GESI:** Using inclusive strategies and pedagogies that promote all learners' wellbeing and develop their potential and promote; • respect for others and alternative views, as well as the awareness of own biases. • protect the weak, work for the betterment of society and make learners advocate for peace and justice. • exhibit empathy towards people with special needs, **SEL:** Learners acquire and employ knowledge, skills, and attitudes to: • cultivate a positive and resilient self-perception, nurturing the development of healthy identities. • skillfully manage and navigate their emotions, promoting emotional well-being and self-awareness. • set and achieve personal and collective goals, fostering growth and fulfillment. • cultivate empathy and compassion for others, demonstrating understanding and kindness. • establish and nurture supportive relationships, promoting a sense of belonging and community.

		• make responsible and ethical decisions, considering the well-being and welfare of themselves and others. By integrating these SEL features into teaching about data storage, teachers can create a supportive and inclusive learning environment. This approach promotes students' emotional well-being, enhances their collaborative and communication skills, and fosters responsible decision-making in implementations and applications of data storage. **National core values:** • Sacrifice • Selflessness • Compassion • Fairness • Justice • Generosity • Cooperation • Commitment • Collaboration • Excellence • Resourcefulness • Self-discipline

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 Data Storage	**Identify, classify and discuss 3 Mass Storage media.** **Group work/collaborative learning:** Divide the class into two groups mixed ability groups and task them to: • Identify, classify, and discuss three types of mass storage media commonly used in computing systems. • Apply knowledge of data storage technologies to solve a given problem, considering factors such as capacity, performance, and reliability. • Engage in group discussions and collaborative activities to explore and analyse real-world scenarios related to data storage solutions, ensuring inclusivity and equity for all learners. **SEL:** When teaching students about Data Storage, teachers can integrate Social Emotional Learning (SEL) principles to create an engaging and supportive learning experience. Here are some SEL features you can incorporate into this specific topic: **Self-awareness:** • provides opportunities for self-assessment of their skills and progress in applying these concepts to manipulate data. • helps students to recognise their emotions and attitudes towards the topic, supporting their self-confidence and self-efficacy. **Self-management:** • guides students in setting goals and planning their work. • fosters resilience and perseverance by supporting students in managing challenges and setbacks they may encounter during the learning process. **Social awareness:** • promotes collaborative learning by assigning group projects or activities to learners. • encourages students to share their knowledge and expertise with their peers, creating a supportive learning community.	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**

	Relationship skills: • promotes teamwork and collaboration by encouraging students to work together to solve complex problems and share their insights and solutions. • emphasises the value of giving and receiving constructive feedback. **Responsible decision-making:** • encourages learners to make informed decisions. • encourages critical thinking and reflection.		
Teaching and Learning Resources	• Notepad or exercise book • Pen • Smartphones • Laptops • Desktop computers • Tablets	• TV and radio • Open Educational Resources (including YouTube, MOOCs - Udemy/Coursera, Khan Academy, and TESSA) • The iBox/iCampus (CENDLOS) • Productivity tools ix. Subject-based application software • Instructional laboratories (with multimedia equipment and smartboards) • Maintenance and repair workshops	• Presentation and demonstration • Enquiry on Critical infrastructure security • Application security, Network security. • Cloud security • Internet of Things (IoT) security

Subject **COMPUTING**
Strand **2. COMPUTATIONAL THINKING (PROGRAMMING LOGIC)**
Sub-Strand **2. APP DEVELOPMENT**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
3.2.2.LO.1		
Explain the concept of Artificial Intelligence and its applications and use the knowledge acquired to distinguish between conventional systems and intelligent systems.	**Creativity and Innovation**: Learners exhibit the capacity to generate original ideas, think outside the box, and approach tasks with a fresh perspective with respect to the Application of Computer Architecture concepts. **Communication**: The skill to effectively express ideas and information through various mediums and engage in active listening by peer-to-peer presentations, etc. **Collaboration and Teamwork**: The ability to work effectively in diverse groups, value different perspectives, and contribute collectively towards shared goals. **Digital Literacy**: The competence to use digital technologies, navigate online information, and apply digital tools effectively and responsibly.	**GESI:** Creating equal opportunities for all learners to participate in class, through gender-balanced groups leads to; • tolerance and respect for each other. • confidence and efficacy in their ability to perform. • awareness of themselves and others taking into consideration their biases and stereotypes. **SEL:** Learners acquire and apply knowledge, skills, and attitudes to: • effectively manage and regulate their emotions, promoting emotional well-being and self-awareness. • develop strategies for evaluating and validating information obtained from AI systems. • set and attain personal and collective goals, fostering growth and accomplishment. • cultivate empathy and compassion for others, demonstrating understanding and kindness.

		• establish and sustain supportive relationships, promoting a sense of belonging and collaboration. • think critically about AI concepts and their application • Make informed and responsible decisions, considering the well-being and welfare of themselves and others. • encourage the creation of a safe supportive classroom environment for learning By integrating these SEL features into teaching about the concept of Artificial Intelligence, teachers can create a supportive and inclusive learning environment. This approach promotes learners' emotional well-being, enhances their collaborative and communication skills, and fosters responsible decision-making in explaining Artificial Intelligence and its applications. With the knowledge acquired, students can distinguish between conventional systems and intelligent systems. **National core values:** • Tolerance • Friendliness • Open-mindedness • Patience • Commitment • Integrity

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 Computational Thinking (Artificial Intelligence)	**Describe the fundamental principles and components of Artificial Intelligence, such as machine learning, neural networks, and natural language processing.** **Discuss real-world applications of Artificial Intelligence, such as image recognition, language translation, and virtual assistants.** **Project-Based Learning Approach:** • Engage in whole-class discussions to explore principles and components of Artificial Intelligence • Conduct practical sessions with individuals and in mixed-ability/gender-sensitive groups. • Employ interactive multimedia presentations and video analysis to facilitate discussions and demonstrate techniques for principles and components of Artificial Intelligence **SEL:** When teaching about Computational Thinking, teachers can integrate Social Emotional Learning (SEL) principles to create an engaging and supportive learning experience. Here are some SEL features you can incorporate into this specific topic: **Self-awareness:** • provides opportunities for self-assessment of their skills and progress in applying these concepts to manipulate data. • helps students to recognise their emotions and attitudes towards the topic, supporting their self-confidence and self-efficacy. **Self-management:** • guides students in setting goals and planning their work. • fosters resilience and perseverance by supporting students in managing challenges and setbacks they may encounter during the learning process. **Social awareness:** • promotes collaborative learning by assigning group projects or activities to learners.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning

	• encourages students to share their knowledge and expertise with their peers, creating a supportive learning community. **Relationship skills:** • promotes teamwork and collaboration by encouraging students to work together to solve complex problems and share their insights and solutions. • emphasises the value of giving and receiving constructive feedback. **Responsible decision-making:** • encourages learners to make informed decisions. • encourages critical thinking and reflection.		
	3.2.2.LI.2		3.2.2.AS.2
	Analyse and compare the advantages and limitations of conventional systems and intelligent systems, considering factors such as problem-solving capabilities, adaptability, and learning capacity. **Project-Based Learning Approach:** • Engage in whole-class discussions to explore conventional systems and intelligent systems, • Conduct practical sessions with individuals and in mixed-ability/gender-sensitive groups. • Employ interactive multimedia presentations and video analysis to facilitate discussions and demonstrate techniques for conventional systems and intelligent systems.		Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Notepad or exercise book • Pen • Smartphones • Laptops	• Desktop computers • Tablets • TV and radio • Open Educational Resources (including YouTube, MOOCs - Udemy/Coursera, Khan Academy, and TESSA)	• The iBox/iCampus (CENDLOS) • Productivity tools ix. Subject-based application software • Instructional laboratories (with multimedia equipment and smartboards) • Maintenance and repair workshops

Subject **COMPUTING**
Strand **2. COMPUTATIONAL THINKING (PROGRAMMING LOGIC)**
Sub-Strand **3. WEB TECHNOLOGIES**

Learning Outcomes	**21st Century Skills and Competencies**	**GESI, SEL and Shared National Values**
3.2.3.LO.1		
Use skills and knowledge acquired to design simple web pages	**Critical Thinking and Problem-Solving:** Learners exhibit the ability to analyse, evaluate, and solve complex problems using logical and creative thinking in designing simple web pages **Creativity and Innovation**: Learners exhibit the capacity to generate original ideas, think outside the box, and approach tasks with a fresh perspective with respect to the Application of Computer Architecture concepts **Digital Literacy**: The competence to use digital technologies, navigate online information, and apply digital tools effectively and responsibly.	**GESI:** Creating equal opportunities for all learners to participate in class, through gender-balanced groups leads to; • tolerance and respect for each other. • confidence and efficacy in their ability to perform. • awareness of themselves and others taking into consideration their biases and stereotypes **SEL:** Learners acquire and utilise knowledge, skills, and attitudes to: • cultivate a positive and resilient self-perception, nurturing the development of healthy identities. • skillfully navigate and regulate their emotions, promoting emotional well-being and self-awareness. • set and achieve personal and collective goals, fostering growth and fulfillment. • cultivate empathy and understanding for others, demonstrating compassion and kindness. • establish and maintain supportive relationships, fostering a sense of belonging and collaboration.

		• make thoughtful and ethical decisions, considering the well-being and welfare of themselves and others. By integrating these SEL features into the teaching of designing web pages, teachers can create a supportive and inclusive learning environment. This approach promotes students' emotional well-being, enhances their collaborative and communication skills, and fosters responsible decision-making in using skills and knowledge acquired to design simple web pages. **National core values:** • Tolerance • Friendliness • Open-mindedness • Patience • Commitment • Integrity

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century and GESI	Assessment
3.2.3.CS.1	3.2.3.LI.1	3.2.3.AS.1
Demonstrate knowledge and understanding of Web development	**Utilise web page editors and design principles to create visually appealing and user-friendly web pages, incorporating sections, text, images, and Graphical User Interface (GUI) elements.** Integrate multimedia elements such as videos, audio, and interactive features into web pages to enhance user engagement. Evaluate and compare different web page editors (e.g., Notepad, Atom, VS Code) and discuss their features and suitability for specific web development tasks. Engage in project-based learning activities, individually or in mixed-ability and gender-sensitive groups, to explore and apply web development tools and techniques. **Project-Based Learning Approach:** • Engage in whole-class discussions to explore and integrate multimedia elements. • Conduct practical sessions with individuals and in mixed-ability/gender-sensitive groups. • Employ interactive multimedia presentations and video analysis to facilitate discussions to integrate multimedia elements. **SEL:** When teaching students about Web development teachers can integrate Social Emotional Learning (SEL) principles to create an engaging and supportive learning experience. Here are some SEL features you can incorporate into this specific topic: **Self-awareness:** • provides opportunities for self-assessment of their skills and progress in applying these concepts to manipulate data. • helps students to recognise their emotions and attitudes towards the topic, supporting their self-confidence and self-efficacy. **Self-management:** • guides students in setting goals and planning their work	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning

	• fosters resilience and perseverance by supporting students in managing challenges and setbacks they may encounter during the learning process. **Social awareness:** • promotes collaborative learning by assigning group projects or activities to learners • encourages students to share their knowledge and expertise with their peers, creating a supportive learning community. **Relationship skills:** • promotes teamwork and collaboration by encouraging students to work together to solve complex problems and share their insights and solutions. • emphasises the value of giving and receiving constructive feedback **Responsible decision-making:** • encourages learners to make informed decisions. encourages critical thinking and reflection. •	
	3.2.3.LI.2	3.2.3.AS.2
	Design an e-commerce web page for a selected company or organisation. **Project-Based Learning:** • Analyse and discuss the concepts and techniques relevant to creating an e-commerce website, including product catalogue, shopping cart functionality, secure payment integration, and user account management. • Utilise interactive multimedia presentations and video analysis to deepen understanding and proficiency in web development practices, while ensuring inclusive strategies for learners with diverse abilities.	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic **reasoning** **Level 4 Extended critical thinking and reasoning**

	3.2.3.LI.3	3.2.3.AS.3
	Understand and Apply Basic Cyber Security Best Practices. • Define cyber security and discuss its goals (Confidentiality, Integrity, Availability, Authentication, Authorization, Auditing). Emphasise its importance and the common cyber threats (e.g., malware, phishing, social engineering). • Demonstrate how to protect personal information (data protection) and set and manage privacy settings on social media and other online platforms. • Explain the best security practices, including using security protocols (e.g., HTTPS, etc.), password security, software and systems updates and patches, two-factor authentication (2FA), VPNs, and anti-malware software such as antivirus and antispyware. • Explain online safety practices (e.g., recognising and avoiding phishing and other social engineering attacks on email, mobile, etc.) **Project-Based Learning Approach:** • Engage in whole-class discussions to explore best cyber security practices. • Conduct practical sessions with learners in mixed-ability/gender-sensitive groups. • Employ interactive multimedia presentations and video analysis to facilitate discussions and demonstrate techniques to discuss cyber threats.	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic **reasoning** **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Notepad or exercise book • Pen • Smartphones • Laptops	• Desktop computers • Tablets • TV and radio • Open Educational Resources (including YouTube, MOOCs - Udemy/Coursera, Khan Academy, and TESSA)	• The iBox/iCampus (CENDLOS) • Productivity tools ix. Subject-based application software • Instructional laboratories (with multimedia equipment and smartboards) • Maintenance and repair workshops