Computational Thinking and Artificial Intelligence

Classes 3-8

Curriculum

CENTRAL BOARD OF SECONDARY EDUCATION

Foreword

The National Education Policy (NEP) aims to position India as a leader in emerging knowledge fields by integrating technologies like Artificial Intelligence, Machine Learning, Big Data, and Computational Thinking into school education. It promotes technology-enabled, interactive, and gamified learning using tools such as Augmented Reality (AR), Virtual Reality (VR), and virtual labs to foster creativity, problem-solving, and interdisciplinary exploration. NCF-SE 2023 carries this recommendation further for implementation.

Key Definitions

Artificial Intelligence (AI) is a broad collection of technologies that enable machines to carry out tasks typically associated with human intelligence — such as learning, comprehension, reasoning, problem-solving, and understanding natural language.

Computational Thinking (CT) is a structured approach to problem-solving that breaks larger problems into smaller, logical pieces, building precise, step-by-step solutions that either a person or a machine can follow.

While AI is an important requirement, CT is a broader skill, developing a foundation for learning.

Under the guidance of the Ministry of Education, Government of India, CBSE presents the Curriculum Framework for CT and AI for Classes 3 to 8. This document posits to integrate CT with AI and other technological advancements, without dependence on any specific platform, focusing on curricular goals, competencies, learning outcomes, and syllabi with necessary details on pedagogy, resources, assessment, and implementation guidelines.

Acknowledgements

Expert Committee

1. Dr. Karthik Raman, Core Leadership, IIT Madras Bodhan AI Foundation; Professor, Department of Data Science and AI, Wadhwani School of Data Science and AI, IIT Madras
2. Dr. Rajesh Kumar, Professor, Department of Electrical Engineering, MNIT Jaipur
3. Dr. Seema Verma, Professor (ECE), Additional Project Director (Siemens CoE), NITTTR, Bhopal
4. Dr. S. Neethi, Core Leadership, IIT Madras Bodhan AI Foundation; Professor of Practice, Department of Data Science and AI, IIT Madras
5. Dr. Arun L. Naik, Associate Professor, Mathematics Education, Azim Premji University, Bengaluru
6. Dr. Aanchal Chomal, Associate Professor, School of Continuing Education and University Resource Centre, Azim Premji University, Bengaluru
7. Dr. Ankit Vijayvargiya, Assistant Professor, School of Technology, Dhirubhai Ambani University, Gandhinagar
8. Sh. R.P. Singh, Associate Professor & Additional Director, CBSE
9. Mr. Mikin Lala (IIT Roorkee and IIM Calcutta Alumnus), Field Expert
10. Ms. Rekha Malhotra (Alumna of British Institute (Business Management and Advertising), Frameworks Mumbai (Advanced Certification in Computer Science), and Workstation (3D Animation)), Field Expert

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Contents

1 Introduction

The National Education Policy (NEP) aims for India to emerge as a global leader in new emerging knowledge domains such as Artificial Intelligence (AI), machine learning (ML), data analytics, and 3-D machining. To realise this goal, the policy suggests teaching students Mathematics and Computational Thinking (CT), along with new subjects such as AI, Machine Learning, Coding, and Data Science, during their school education.

The National Curriculum for School Education draws from this policy aspiration and emphasises the need to introduce these emerging domains in the school curriculum. It recommends inclusion of subjects such as design thinking, augmented reality, virtual reality, AI, and CT. Additionally, it encourages the use of gamified content, interactive content, and immersive experiences (e.g., Augmented Reality (AR), Virtual Reality (VR), virtual labs) to enhance student learning across design, music, art, and sciences, and support students in knowledge creation and exploration, and development of capacities such as problem-solving, critical, and creative thinking.

2 Summary

This curriculum aims to develop **AI-Ready learners** by focusing on CT Skills. The AI-readiness so inculcated will help develop learners' capacities for logical thinking, problem-solving, and pattern recognition, and for understanding the role and use of AI in daily life.

Curriculum Aims

- Build strong foundations in CT, digital literacy, and responsible use of technology.
- Nurture innovation, critical thinking, and ethical decision-making capacities.
- Enable learners to develop the ability to think logically, approach and solve problems systematically, find patterns, and apply technology for solving day-to-day life problems.
- Understand the ethical use of technology and the relevance of AI in daily life.
- Build strong foundations in CT, digital literacy, and responsible technology use.
- Encourage students to think creatively, solve problems, and make ethical choices and equip them with the capacities and tools needed for higher education, profession and everyday life.

Research articles present CT as the key underlying foundation for AI, showing that skills like breaking problems into parts, spotting patterns, filtering essential information, and designing step-wise procedures are the same reasoning processes that power AI and ML systems. This curriculum positions CT as a foundation needed for learning all the subjects, including AI. It also envisages integrating CT across school subjects, including beyond Mathematics, as a cross-cutting theme.

2.1 Progression Across Class Levels

Classes 3–5 (Preparatory Stage)

At present, CT is part of the Mathematics curriculum in the school curriculum. The curriculum recommends embedding CT in all the subjects, such as TWAU (The World Around Us) and Mathematics, with focused learning experiences through workbooks.
Time allocation: 50 hours annually.

Classes 6–8 (Middle Stage)

At this stage, CT is again incorporated into all the school subjects through worksheet- and project-based learning, along with an introduction to foundational concepts of AI (AI literacy).
Time allocation: 100 hours annually.

The teaching of CT and AI should reflect real-world challenges, focusing on hands-on experiences. To achieve this, a variety of engaging pedagogical methods, such as puzzles, structured problems, collaborative and individual projects, demonstrations, practice sessions, discussions, debates, and reflective exercises, are crucial. Students should be allowed to explore the practical challenges faced by the community, devise solutions for them, and apply the knowledge beyond the classroom. Teachers would need to provide the mentorship needed for such explorations.

The **assessment methods** need to align with these curricular intentions and the pedagogical practices to ensure authentic assessment. For Classes 3–5, assessments will be linked to core subjects such as Mathematics and TWAU. From Class 6 onwards, evaluations will focus on project presentations, assignments, reflective journals, and assigned tasks. Teachers need to create clear and consistent rubrics to evaluate student performance, ensuring consistency and clarity in the assessment process.

CT forms the basis of learning AI. So, the curriculum will begin with an introduction to CT and deepen it as we move through the stages. AI is introduced later, once the pre-requisite knowledge of CT is built for understanding AI. Implementation across classes follows this principle of a phased approach. Thus, for Classes 3–5, Mathematics and other subject teachers will deliver the CT syllabus. For Classes 6–8, the curriculum entails advanced CT, interdisciplinary projects and basic concepts of AI. This requires collaboration among teachers of various subjects.

Resources: For effective implementation of the curriculum, supportive materials such as teacher manuals and resource books will be provided. There will be flexibility for schools to choose the platform for executing projects and assignments, without being tied to specific software or technology. The curriculum framework recommends harnessing the potential of free and open-source tools to ensure accessibility and adaptability for all institutions.

3 Approach

3.1 Approach to Learning Standards

Learning standards are derived using the approach suggested in and aligned to NCF-SE 2023. As articulated in NCF-SE, the approach used is elaborated as follows:

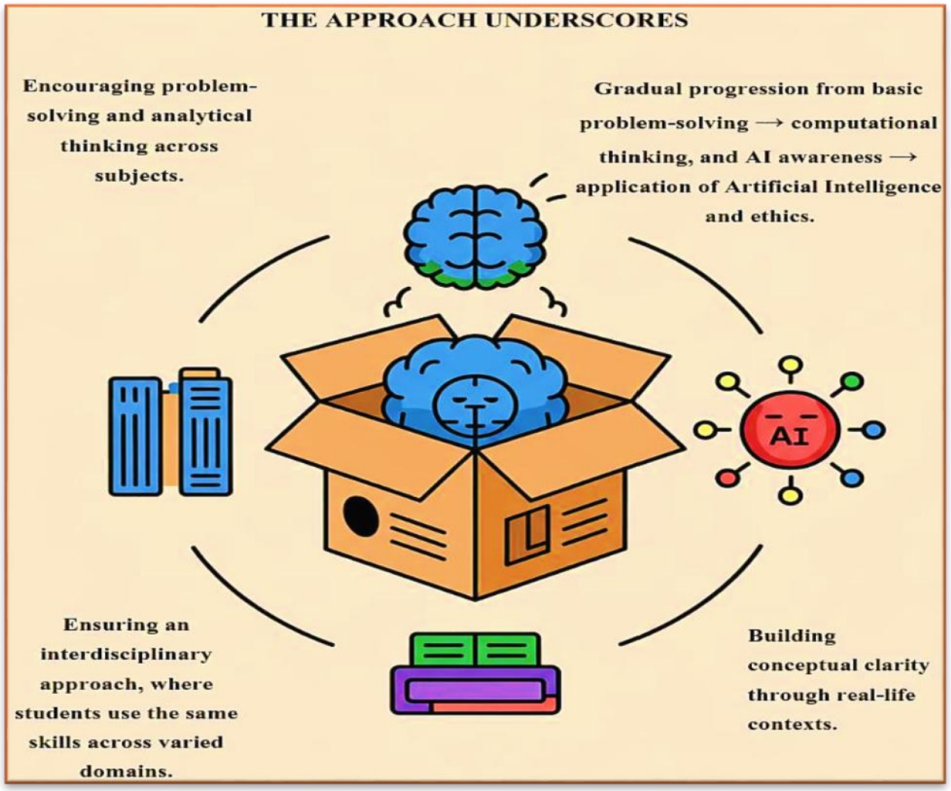
"*NEP 2020 has articulated the vision and purpose of education. NCF has drawn the Aims of School Education from this vision, which informs the knowledge, capacities, values, and dispositions that must be developed in students in order to achieve the aims of education. The aforementioned desirable knowledge, capacities, values, and dispositions are thereby reflected in the aims of each subject of study, and also in the recommended school culture and practices.*

The Curricular Goals are, in turn, derived from the Aims of Education, along with other relevant considerations. The Competencies are then drawn from these Curricular Goals, and the Learning Outcomes from those Competencies" (NCF-SE p. 90).

For this curricular area, learning standards are designed as **foundational capacities** that cut across disciplines, are progressive, and age-appropriate. They are integrated into Mathematics, Science, Language, and Social Sciences in the lower classes and evolve into distinct subjects in higher classes.

The approach underscores:

- **Problem-solving and analytical thinking** as a core across subjects.
- **Gradual progression**: basic problem-solving → CT → AI awareness → application of AI and ethics.
- **Interdisciplinary approach** exposing students to CT & AI across varied domains.
- **Building conceptual clarity** through real-life contexts and experiential learning.



3.2 Content

Content is reinforced and advanced through **spiral arrangement** across classes. The NCF-SE serves as the foundation for selecting the content. In the lower classes, it is built upon the content prescribed in NCF-SE and is enriched further. As students progress to higher classes, the content evolves into distinct subjects. The outline of the key content areas across various class levels is as follows:

- **Preparatory Stage (Classes 3–5):** Puzzles, visual reasoning, and problems that require analytical thinking, logical deduction, and basic problem-solving in everyday contexts.
- **Middle Stage (Classes 6–8):** Advanced CT, data organisation, representation and analysis, AI awareness, and ethical aspects of AI.

3.3 Pedagogy and Assessment

Pedagogy suggested is activity-based and experiential, engaging students through interactive and hands-on experiences.

- *Classes 3–5:* Worksheets based on games, puzzles, and activities to enhance CT skills and creativity.
- *Classes 6–8:* Hands-on and real-world problems, collaborative and group work to solidify and apply multidisciplinary foundational knowledge on coding, data analysis, and AI tools, aiming to learn advanced CT and problem-solving skills.

Assessment approaches need to move away from traditional summative assessment to continuous, formative, and competency-based assessment. A range of assessment tools, such as problem-solving tasks, project work, reflective journals, and discussions/debates on ethical dilemmas, are to be used to assess student learning. The focus of assessment should be on the ability to apply knowledge, assessing creativity, and the development of ethical reasoning skills, rather than assessing rote memorisation. With its focus on practical application and critical thinking, these assessment strategies aim to provide a more comprehensive understanding of student learning and development.

3.4 Time Allocation

Stage	Hours/Year	Mode of Delivery
Preparatory stage (Classes 3–5)	50	Integrated into Mathematics & TWAU; CT will be integrated with the existing textbook content, with additional CT questions and activities (via resource books) added into appropriate chapters.
Middle stage (Classes 6–8)	100	Specific topics on basics of AI and interdisciplinary projects.

The above time allocation is suggested to maintain the existing curriculum load and ensure balance without overburdening students with additional content. It is flexible, and schools can go beyond the allocated time depending on the needs of the school.

4 Significance of CT and AI in School Curriculum

What is CT?

CT is a problem-solving approach comprising **Decomposition, Pattern Recognition, Abstraction, Algorithm Design, Data Analysis,** and **Troubleshooting**. CT skills promote critical and creative thinking, abstraction and pattern recognition, as well as algorithmic thinking. Problem identification and problem solving necessitate the application of multidisciplinary understanding to create effective solutions.

What is AI?

AI is a cutting-edge technology that empowers machines and computers to perform tasks usually requiring human intelligence. These machines can perform complex human thinking processes such as data analysis, pattern recognition, prediction of trends, solving problems and decision making. Thus, AI involves automation of cognitive processes associated with human intelligence, and is widely applicable in various sectors such as banking, healthcare, defence, education, entertainment, agriculture and others for processing information, solving complex problems and planning.

Why a Curriculum for CT and AI?

Research shows that CT is the **intellectual backbone** through which meaningful AI literacy and capability develop. Research presents CT as the underlying foundation for AI, showing that skills like breaking problems into parts, spotting patterns, filtering essential information, and designing step-wise procedures are the same reasoning processes that power AI and ML systems. It suggests that when students practice CT in real STEM problem-solving, they are naturally building the cognitive structures required to understand and eventually create AI-driven solutions[1].

Research also proposes that CT constitutes a foundational cognitive framework for engaging with AI, insofar as its core elements—such as abstraction, decomposition, and algorithmic reasoning—provide the essential scaffolding for understanding how intelligent systems operate.

The future of education lies not in avoiding AI, but in integrating it with thoughtful, disciplined, and human-centred learning. Regular instruction on AI ethics teaches students to verify information, detect bias, and recognise when AI reliance crosses into cognitive delegation or cognitive over-reliance.

In the above context, CBSE proposes a curriculum, *Computational Thinking and Understanding AI: Building AI-Readiness* from Class 3 onwards to develop AI-Ready learners. The AI-readiness, so inculcated through CT Skills, will help *develop the capacities of learners to use CT, such as logical thinking, problem-solving, pattern recognition, and so on, and understand the role and use of AI in daily life. The curriculum aims to build strong foundations in CT, digital literacy, and responsible use of technology, along with nurturing innovation, critical thinking, and ethical decision-making capacities.*

[1] Asunda, P., Faezipour, M., Tolemy, J., & Engel, M. (2023). Embracing computational thinking as an impetus for artificial intelligence in integrated STEM disciplines through engineering and technology education. *Journal of Technology Education*, **34**:43–63. https://doi.org/10.21061/jte.v34i2.a.3

Five Reasons for this Curriculum

1. **Preparing for the future:** Problem-solving, effective use of data, pattern identification, and ethical AI application.
2. **Holistic Development:** Reasoning, logical thinking, creative problem-solving, and ethical decision-making leading to individual flourishing.
3. **Interdisciplinary Relevance:** Connecting Mathematics, Science, Humanities, and Technology for enriched, integrated learning.
4. **Innovation and Entrepreneurship:** CT and AI nurture entrepreneurial and innovative mindsets.
5. **Ethical Awareness:** Sensitising learners to misuse, bias, fairness, and inclusivity in AI systems.

We need this curriculum for:

1. **Preparing for the future**: To contribute to the world of work in modern societies, individuals need capabilities such as problem solving, using data effectively, identifying patterns, and applying AI ethically for various purposes in life. Studying CT and AI equips individuals with such capacities.

2. **Holistic Development**: Study of CT and AI contributes to the development of reasoning, logical thinking, creative problem-solving skills, critical thinking, and ethical decision-making abilities, leading to the individual flourishing. It leads to the creation of **responsible digital citizens** in society.

3. **Interdisciplinary Relevance**: Embedding CT and AI concepts in the school curriculum helps students develop an integrated view of the world by **connecting various disciplines** such as Mathematics, Science, and Humanities. This will lead to an **enriched learning experience** and help students realise that knowledge is not compartmentalised.

4. **Innovation and Entrepreneurship**: At the core, CT and AI are about solving problems, devising innovative solutions and recreating human thinking. This leads to an entrepreneurial and innovative mindset in the learners.

5. **Ethical Awareness**: While CT and AI ease life, they call for responsible use to promote a better life for individuals. The study of CT and AI will sensitise learners about the misuse and bias, fairness and inclusivity in AI systems, which are becoming increasingly important in this digital age.

In essence, the aim of CT & AI curriculum is to transform learners into informed, creative and ethically aware digital citizens committed to the use of technology for human welfare by empowering learners with the knowledge, capacities and dispositions needed to thrive in a technology-driven society.

5 Aims of the Curriculum

Development of Cognitive Capacities — *Logical thinking, critical thinking, visual and spatial thinking, and analytical thinking, enabling learners to face real-life problems with confidence.*

The study of CT and AI enables individuals to approach problems systematically through structured methods. This results in the development of cognitive capacities such as logical thinking, critical thinking, visual and spatial thinking, and analytical thinking. It also enables learners to face real-life problems with confidence and overcome the challenges of day-to-day life by analysing complex problems into sub-components, the ability to see patterns, and creating innovative solutions. The learners attain fluency in using systematic and methodical approaches to solve problems and create more efficient and effective solutions to problems across various aspects of life.

Integration of Knowledge Across the Curriculum — *Seamlessly integrating ideas from Mathematics, Science, Humanities, and Technology while designing creative solutions.*

Designing solutions to real-life problems requires an integrated and holistic approach. This requires learners to seamlessly integrate ideas from various disciplines, such as Mathematics, Science, Humanities, and Technology. CT and AI provide opportunities for learners to bring these knowledge domains together while they design creative solutions to the problems they encounter every day, both at the individual and societal levels. They will explore the interconnections among these knowledge domains and leverage one domain for deepening the understanding of another domain. This will also help them appreciate the relevance of these domains in their daily life. This interdisciplinary perspective gives them a holistic and deeper understanding of the world and prepares individuals to adapt and thrive in the modern world, marked by a complex and dynamic environment.

Readiness for an AI-Driven World — *Building foundational competencies in CT and an understanding of AI; developing 21st-century skills including problem-solving, logical reasoning, creativity, collaboration, and informed decision-making.*

Modern life is technology-driven, and various tools of technology, such as Python programming, help in modelling, simulating and solving real-world problems. Machine learning is widely used to perform pattern recognition, predict and make varied kinds of representations. To prepare learners for this technology-driven future, it is important to build foundational competencies in CT and an understanding of AI.
CT in classes 3–5 would encourage learners to approach problems in a systematic and logical manner by applying processes such as decomposition, pattern recognition, abstraction, and algorithmic thinking. Through exposure to AI and CT concepts at the middle school level in classes 6–8, learners develop important 21st-century skills such as problem-solving, logical reasoning, creativity, collaboration, ability to adapt and keep pace with evolving technologies, and informed decision-

making. It will also help them understand the responsible and ethical use of technology and enable them to think critically about how technology impacts individuals, communities, and society. Mastery of these skills will help individuals navigate complex challenges, drive technological advancements, and make decisions that positively impact society, ultimately becoming adept at applying technology for self and societal welfare.

Promoting Core Competencies — *Clarity of thought, communication, accommodating diverse views, collaborative work, growth mindset, and lifelong learning.*

To succeed in personal and professional lives, learners need to develop capacities such as clarity of thought and expression, communicate them to others, accommodate diverse views and collaborate with each other. Working in collaborative groups ensures collective success, teamwork, mutual respect and appreciation. By enhancing collaborative learning and adaptability, individuals can remain relevant and effective throughout their lives, whether through lifelong learning or peer learning. This leads to a growth mindset, staying ahead of the curve in an ever-evolving landscape.

Learning standards *have been contextualised, mapping them across all subjects, and viewed as a foundational capacity to be used across all subjects, thereby encouraging an interdisciplinary approach.*

6 Curricular Goals and Competencies

6.1 Classes 3–5

Curricular Goal	Competencies
CG-1 Develops basic problem-solving skills with procedural fluency to solve daily-life problems, as a step towards CT.	C-1: Solves puzzles and daily-life problems through visual representations, interpreting the texts and analysing the given information. C-2: Solve problems and understand complex ideas by identifying patterns, applying patterns to new cases, rules, and relationships in abstract, non-verbal information (shapes, symbols, diagrams).
CG-2 Develop basic capacities of analytical thinking, verbal, and visual reasoning.	C-3: Learns to systematically count and list all permutations or combinations given a constraint, in simple situations. (e.g., how to form a committee of two people from a group of five people). C-4: Selects appropriate methods and tools for computing simple data, such as mental computation, estimation, or paper and pencil calculation, in accordance with the context. C-5: Makes connections among concepts, procedures, and representations in problem-solving contexts.

Curricular Goal	Competencies
CG-3 Demonstrate understanding of basic computer concepts, including hardware and software.	C-6: Develops familiarity with parts of a computer, input/output devices, file management, internet safety, educational software, and block-based coding (e.g. Scratch).

6.2 Classes 6–8

Curricular Goal	Competencies
CG-1 Develops CT skills: decomposition, pattern recognition, data representation, generalisation, abstraction, and algorithms to solve problems where such techniques of CT are effective.	C-1: Approaches problems using programmatic thinking techniques such as iteration, symbolic representation and logical operations, and reformulates problems into a series of ordered steps. C-2: Learns systematic arithmetic reasoning, iterative patterns, and multiple data representations, to devise and follow algorithms, with an eye towards understanding correctness, effectiveness, and efficiency of algorithms.
CG-2 Develops spatial and visual reasoning.	C-3: Learns to visualise, manipulate, represent, and understand spatial relationships between objects.
CG-3 Gain foundational knowledge of AI, its types, and domains.	C-4: Applies abstraction and generalisation to identify core structures and patterns enabling reusable procedures. C-5: Demonstrate knowledge of AI tools through different projects and activities.
CG-4 Understand key ethical terms such as bias and fairness in relation to AI.	C-6: Identifies ethical issues and applies ethical principles to make informed decisions regarding AI usage.
CG-5 Demonstrates proficiency in using a computer and other devices, computer applications for learning and practical purposes, such as data analysis, preparation of visual representations and communication of ideas.	C-7: Uses computers or any other appropriate devices and software/applications for creating visual representations of ideas, organising and analysing data, conducting simple online research, gathering images, and designing infographics.

7 Approach Across School Stages

7.1 Classes 3–5

- Begin with integration of CT across subjects taught at this stage, i.e. in Mathematics and The World Around Us (TWAU).
- CT at this stage has already been integrated into Mathematics, but it needs further emphasis. The curriculum suggests CT worksheets and resource books to further enrich Mathematics lessons.
- Similarly, for other subjects, additional CT worksheets are to be designed to enrich the existing chapters.
- The goal at this stage is to develop foundational CT skills such as the ability to think logically, find patterns, and arrange things in order using fun math games, puzzles, and exercises.
- Use simple digital tools and hands-on activities to help children think in an organised way and solve problems effectively.

7.2 Classes 6–8

- At this stage, CT skills are furthered to the advanced level, and an introduction to foundational understanding of AI will be done.
- The best approach is to have a combination of CT worksheets along with an introduction to basic AI theory, and interdisciplinary projects that combine both CT and AI in the middle school stage.
- Use additional materials, such as worksheets, and teacher and student handbooks to integrate CT with other subjects. Include more challenging questions than those in Classes 3-–5.
- Teaching students the fundamentals of artificial intelligence with relatable real-world examples will help them understand AI's role in society.
- Using project-based learning with AI tools, basic data analysis, and CT will help students create solutions to real-world issues.
- Introducing conversations about digital footprints, bias, privacy, and fairness in AI systems to cultivate conscientious, ethical, and thoughtful digital citizens.
- Encourage critical thinking, creativity, and curiosity through experiential, inquiry-based learning opportunities.

8 Materials and Resources

8.1 Who Will Teach?

Stage	Teaching Arrangement
Classes 3–5	**CT taught as part of Mathematics and other subjects by subject teachers using special worksheets and handbooks.** Special worksheets and handbooks would be given to both teachers and students. These worksheets will follow the same topics as the textbooks in the respective subjects and will include CT-based questions and activities for various chapters. CT activities would be integrated with the concepts of each subject. Teachers will use these resources during their regular classes, which will help the students to practice CT while understanding subject concepts.
Classes 6–8	**Collaboratively by respective subject teachers (for CT resources) and Computer teachers (for AI Literacy resources).** The Middle Stage curriculum will comprise two core components: Intermediate CT and Introduction to AI Literacy. Related content transactions will be facilitated through a combination of dedicated CT worksheets and handbooks, an AI Foundation Handbook, and project-based learning modules. In alignment with the approach adopted for Classes 3—5, CT Resource Books will integrate CT-based questions and activities within chapters Projects integrating concepts from both CT and AI will form a key part of the learning process and will be assessed by the Computer teacher.

8.2 Materials

- **Classes 3–5:** A resource book with additional CT questions and activities would be provided for students and teachers.
- **Classes 6–8:** A resource book including complex CT questions, AI foundation concepts, and details of interdisciplinary projects, accompanied by corresponding teacher manuals.

The curriculum recommends harnessing free and open-source tools to ensure accessibility and adaptability for all institutions.

9 Pedagogy and Assessment

9.1 Pedagogical Approaches

Stage	Approaches
Classes 3–5	• Hands-on activities, games, and puzzles to teach problem-solving using the worksheets • Allowing students to interpret charts, diagrams, and any other visual representations • Teach students to break larger problems into smaller ones, to develop problem-solving skills • Use collaborative tasks and peer discussions while solving problems using the worksheets.
Classes 6–8	• Use complex puzzles, riddles, and games to build on the CT abilities taught in the previous stage • Deliver fundamental concepts of AI through explanations, demonstrations and hands-on experiences. • Organise group discussions, design collaborative projects that integrate CT and AI. Offer guidance to students to carry out these projects. • Independent activities for students such as data collection, organisation and analysis, varied forms of representations, creation of diagrams, and flow charts, etc., created using digital tools or manually. • Discussions, debates and case studies on ethical use of AI.

9.2 Assessment Approaches

Assessment approaches should focus on demonstrable outcomes to assess students' abilities to apply, design solutions and ethical use of AI. This necessitates the use of a variety of assessment methods such as hands-on activities, collaborative and individual projects, reflective journals, peer assessment, and observation by the teachers. Below are the suggestive stage-specific assessment methods:

Stage	Assessment Methods
Classes 3–5	Written tests with CT questions and puzzles; interactive group activities (e.g. treasure hunts); Teacher Observation Journal.
Classes 6–8	Written tests; interactive group activities; practical examinations; Teacher Observation Journal; thematic projects; reflections and group discussions.

10 Syllabus

10.1 Classes 3–5

CT will be embedded into the existing Mathematics and TWAU curricula for Classes 3–5 and will closely align with the content of the textbooks for these two subjects. Each class will be provided with a resource book that includes additional CT-focused questions designed to strengthen a range of CT skills. The resource book will maintain the same table of contents as the subject textbook, with CT questions integrated into each chapter. This structure will enable teachers to seamlessly address these questions while teaching the corresponding subject concepts.

10.1.1 Learning Outcomes

Grade 3

Abstract Thinking

Students will solve problems with hidden or unseen ideas using:

- Different viewpoints of 3-D objects
- Changes in shapes after flips, turns, folds, or rotations
- Hidden or missing parts in incomplete shapes or patterns

Pattern Recognition

Students will be able to identify simple patterns involving 1 or 2 changes in consecutive terms, using numbers, shapes/images, letters, or a mix.

Decomposition

Students will be able to break down problems involving 2–3 clues from: number clues/names; 3-D objects and their parts (faces, edges, corners); step-by-step exchanges or transfers (money, objects, digits); tables or charts with multiple pieces of information.

Algorithmic Thinking

Students will be able to follow clear step-by-step rules to solve problems involving:

- Number sequences formed using simple operations
- Movements on grids or direction-based paths
- Events arranged using before/after/in-between clues
- Values that increase or decrease across steps
- Multi-step instructions involving moves, changes, or transfer

Grade 4

Abstract Thinking

Students will be able to solve moderate to highly moderate problems with partially visible or incomplete ideas, using:

- Different viewpoints of 3-D objects
- Changes in shapes after flips, turns, cuts/folds, or rotations
- Hidden or missing parts in incomplete shapes or patterns
- Mirror images and identical halves based on symmetry

Pattern Recognition

Students will be able to identify patterns involving one or more changes, using numbers, shapes/images, letters, or a mix.

Decomposition

Students will be able to break down problems involving a cluster of moderate clues, using information from:

- Number clues (place values, sum/difference/product)
- 3-D objects and their parts (faces, edges, corners)
- Step-by-step exchanges or transfers (money, objects, digits, quantities)
- Tables or charts with multiple pieces of information
- Conditions for counting/grouping/sorting items

Algorithmic Thinking

Students will be able to follow a set of well-defined, elaborate conditions to solve moderate to complex problems involving:

- Number sequences formed using simple operations
- Movements on grids or direction-based paths
- Values that increase or decrease across steps
- Multi-step instructions involving moves, changes, transfers, swaps
- People/Events arranged in an order using attributes or chronological clues
- Simple counting instructions

Grade 5

Abstract Thinking

Students will be able to solve complex problems with multi-layered hidden cues, using:

- Different viewpoints of 3-D objects
- Changes in shapes after flips, turns, cuts/folds, or rotations, and changes in order and directions (clockwise or counter-clockwise)
- Hidden or missing parts in incomplete shapes or patterns
- Mirror/water images and identical halves based on symmetry

Pattern Recognition

Students will identify progressive patterns involving multiple changes, using numbers, shapes/images, letters, or a mix.

Decomposition

Students will be able to break down higher-order problems involving interconnected clues, using information from:

- Number clues (place values, sum/difference/product)
- 3-D objects and their parts (faces, edges, corners)
- Step-by-step exchanges or transfers (money, objects, digits, quantities)
- Tables or charts with multiple pieces of information
- Conditions for counting/grouping/sorting items
- Pictures or visuals that represent certain numerical values

Algorithmic Thinking

Students will be able to follow multi-layered rules to solve advanced problems involving:

- Number sequences formed using simple operations
- Movements on grids or direction-based paths
- Values that increase or decrease across steps
- Multi-step instructions involving moves, changes, transfers, swaps
- People/Events arranged in an order using attributes or chronological clues
- Simple counting instructions

10.2 Classes 6–8

Component	Hours/Year	Description
Advanced CT Skills	40	Builds on Classes 3–5; complex situations
Introductory AI Concepts	20	Foundational AI; exposure to AI tools
Interdisciplinary Projects	40	Cross-subject projects applying CT & AI

The syllabus for Classes 6–8 comprises three components:

Advanced CT skills: The syllabus will build on the earlier classes and provide an opportunity to apply CT skills to complex situations in tandem. Total time allocated to this is 40 hours per academic year.

Introductory concepts of AI: The syllabus extends the CT skills the students have gained to AI. They will be introduced to the fundamental concepts of AI and exposed to AI tools in this school stage. The total time allocated to these concepts is 20 hours per academic year.

Interdisciplinary projects: These encourage students to use their understanding of CT and AI to analyse problems, draw connections across disciplines, and design creative, data-driven solutions. These projects are designed to integrate concepts from various subjects, such as Mathematics, Science, Social Studies, and English, allowing students to apply their learning in authentic, real-world contexts. Each activity is carefully curated to make learning engaging and hands-on rather than academically demanding, promoting curiosity, collaboration and innovation. *Through these experiences, students not only strengthen their CT and AI skills, but also develop critical thinking and an appreciation for the interconnected nature of knowledge.*

10.2.1 Learning Outcomes

Class 6 — CT

Abstract Thinking

Students will be able to interpret and solve multi-step problems with layered and abstract clues, using:

- Advanced viewpoints and cross-sections of 3-D objects
- Combined transformations of shapes (multiple flips, rotations, reflections, cuts/folds)
- Changes in orientation, position, order, and direction (clockwise, counter-clockwise, diagonal)
- Identifying hidden, overlapping, or implied parts in complex visual patterns
- Symmetry across multiple axes and composite mirror/water image reasoning
- Visual reasoning involving scale, proportion, and spatial relationships

Pattern Recognition

Students will be able to identify, extend, and justify complex patterns involving multiple simultaneous changes, formed using:

- Numbers with mixed operations and logical rules
- Shapes/images with changing attributes (size, position, count, orientation)
- Letters and symbols with positional or alphabetical logic
- Patterns involving alternation, skipping, grouping, or cyclic behaviour
- Mixed patterns combining numbers, shapes, and letters with dependency rules

Decomposition

Students will be able to break down higher-order problems involving interdependent clues and constraints, using information from:

- Numerical clues involving place value, operations, factors, multiples, and comparisons
- Properties of 2-D and 3-D shapes (faces, edges, vertices, diagonals, angles
- Multi-step transfers or exchanges (money, quantities, digits, objects) with conditions
- Tables, grids, or charts requiring cross-referencing of multiple data points
- Conditional rules for counting, grouping, sorting, or eliminating possibilities
- Visual representations that encode numerical or logical values

Algorithmic Thinking

Students will be able to follow, analyse, and apply multi-layered rules and procedures to solve complex problems involving:

- Number sequences formed using combined operations and logical conditions
- Movement on grids involving direction, distance, turns, and path constraints
- Step-wise changes where values increase/decrease based on rules
- Multi-step instructions involving swaps, shifts, transfers, and rearrangements
- Ordering people, objects, or events using multiple attributes or clues
- Logical flow of steps, identifying necessary vs redundant information

Class 6 — AI

Learners will be able to:

- Summarise basic ideas and concepts of AI and its applications.
- Describe key differences between machine intelligence and human intelligence.
- Explain the difference between automation and AI using practical, real-world cases.
- Differentiate the three fundamental AI methodologies: supervised, unsupervised, and reinforcement learning.
- Develop the skill of organising and representing data in various forms, including text, numbers,

images, and sounds.

- Recognise simple patterns in data and make decisions based on observations.
- Demonstrate understanding of ethics and digital responsibility in the use of AI, including digital footprints, privacy, and responsible technology behaviour.
- Practice essential internet safety protocols, such as creating secure passwords, maintaining safe online behaviour, and applying basic privacy measures, while using digital and AI tools.
- Apply conceptual knowledge of AI to everyday activities by recognising human-centred design and ethical principles in how AI works and interacts with people.

Class 7 — CT

Abstract Thinking

Students will be able to interpret and solve complex, multi-layered problems by:

- Visualising and analysing 3-D objects and their transformations, including rotations, reflections, cross-sections, and nets
- Understanding compound transformations involving multiple flips, turns, folds, and rearrangements
- Identifying hidden relationships and constraints within incomplete figures, patterns, or logical setups
- Analysing symmetry, congruence, and proportional reasoning across different representations
- Interpreting relative positions, orientations, and viewpoints of objects in advanced visual scenarios

Pattern Recognition

Students will be able to recognise, extend, and predict complex patterns involving:

- Multi-rule numerical sequences, including alternating, nested, and dependent patterns
- Algebraic patterns using variables, expressions, and functional relationships
- Visual and geometric patterns formed through transformations or growth rules
- Letter and symbol-based patterns involving positional and logical dependencies
- Integrated patterns combining numbers, shapes, symbols, and logical conditions

Decomposition

Students will be able to break down real-world and abstract problems by:

- Separating interconnected conditions and constraints into manageable components
- Analysing number properties (factors, multiples, ratios, percentages, powers) within layered clues
- Deconstructing problems involving spatial reasoning, measurements, and geometry
- Interpreting tables, grids, charts, and flow-based information with multiple dependencies
- Breaking multi-step logical situations (movement, exchanges, comparisons, scheduling) into

ordered steps
- Translating visual or verbal information into structured data for systematic analysis

Algorithmic Thinking

Students will be able to design and follow logical procedures to solve advanced problems involving:
- Rule-based sequences and algorithms with conditional branching
- Grid-based navigation and pathfinding with constraints and decision points
- Step-wise transformations involving calculations, swaps, transfers, or positional changes
- Ordering and arranging elements (people, objects, events) using multiple attributes and logical clues
- Solving problems using if–then reasoning, elimination strategies, and logical consistency checks
- Creating or analysing procedural steps to reach an optimal or valid solution

Class 7 — AI

Learners will be able to:

- Distinguish key predictive techniques such as:
  - **Regression** — predicting a number based on patterns in past data
  - **Classification** — arranging things in groups based on learned patterns
  - **Clustering** — automatically grouping similar items together
- Explain key AI domains of AI, namely
  - **Data Science**: learn to manage and extract insights from data
  - **Computer Vision**: learn the basics of how machines understand and respond to visual information
  - **Natural Language Processing**: understand the basics and limitations of how computers process and handle natural language inputs
- Explain what bias in AI means, and identify situations where AI can give unfair results
- Demonstrate courteous, safe, and responsible use of technology as part of good digital citizenship
- Use safe practices for maintaining data privacy, including giving informed consent before personal data is collected, used, shared, archived, or deleted
- Collect and organise simple structured data, interpreting patterns and trends, and create bar charts, line graphs and pie charts
- Apply basic predictive approaches/techniques to a small dataset
- Explain uses of AI in healthcare, education, transport, and communication

Class 8 — CT

Abstract Thinking

Students will be able to solve advanced, multi-layered problems involving abstract relationships and hidden structures, using:

- Properties and relationships of numbers (powers, factors, remainders, divisibility)
- Generalisation across different number systems (decimal, binary, ternary, Roman, Chinese numerals)26
- Spatial visualisation of 2-D/3-D figures, including overlaps, intersections, and transformations
- Logical interpretation of symbols, codes, and operations representing numerical or algebraic ideas
- Identification of essential information by ignoring irrelevant or misleading data

Pattern Recognition

Students will be able to identify, compare, and extend complex patterns involving multiple simultaneous changes, formed using:

- Powers, exponents, and numerical structures
- Relationships across different representations of the same number
- Geometric configurations and shape-based sequences
- Conditional patterns based on rules, constraints, or dependencies
- Mixed patterns involving numbers, symbols, shapes, and movement

Decomposition

Students will be able to break down high-order logical problems into manageable components by:

- Separating given conditions, constraints, and goals
- Analysing multi-step processes such as distribution, transfers, and exchanges
- Breaking numerical expressions into simpler equivalent forms
- Interpreting tables, grids, networks, and diagrams with multiple dependencies
- Structuring problems involving multiple variables, positions, or cases

Algorithmic Thinking

Students will be able to design, follow, and evaluate multi-step logical procedures to solve problems involving:

- Rule-based transformations of numbers or symbols
- Step-wise movement on grids, tracks, or paths with constraints
- Conditional instructions (if–then, either–or, must/must not)
- Sequential decision-making under given limitations
- Optimisation problems involving maximum or minimum outcomes

Class 8 — AI

Learners will be able to:

- Describe the stages of the AI project cycle: Define Problem, Collect Data, Test AI Tools, Reflect and Improve
- Apply no-code tools to tackle real-world problems and reflect on their utility/effectiveness
- Explain how AI uses data, find and research sources of bias in datasets, and apply basic strategies to ensure fairness and inclusivity
- Recognise how bias in AI leads to unfair conclusions and realise the importance of accountability, privacy, and serving human interests
- Explain the uses of AI in daily life and understand AI as a specific type of algorithm that uses datasets, learning, and prediction
- Analyse contributions of AI to fields like healthcare, automation, and education, understanding both benefits and risks
- Describe AI ethics as the values and guidelines that ensure AI is created and used responsibly

10.2.2 Syllabus for Advanced CT Skills (Classes 6–8)

For Classes 6–8, the CT curriculum will build upon the foundational skills developed in Classes 3–5, introducing more advanced applications and problem-solving tasks. The design of the curriculum will be closely aligned with the mathematics textbooks for each class, ensuring seamless integration of CT concepts into existing topics. The accompanying resource book will parallel the structure of the mathematics textbook while incorporating targeted CT exercises in every chapter. This approach will allow teachers to naturally reinforce and expand CT skills as they progress through the mathematics curriculum.

10.2.3 Syllabus for Early AI (Classes 6–8)

Duration: 20 hours per class

Class 6 — AI Syllabus

#	Content	Hours
1	**Introduction to AI & Everyday Examples** — Understanding what AI is; Difference between AI and Automation; Comparison between human and machine intelligence; Introduction to AI concepts and its types (supervised, unsupervised, and reinforcement learning)	05
2	**Basic Data Concepts** — Introduction to data types (numbers, text, images, sound); Simple data organisation and representation using tables or charts	05

#	Content	Hours
3	**Simple Pattern Recognition & Decision Making** — Identifying patterns in data or daily routines; Making simple decisions based on observations	05
4	**Ethics and Digital Responsibility** — Basic online safety, privacy, passwords, and ethical use of technology; Understanding digital footprints	05
	Total	**20**

Class 7 — AI Syllabus

#	Content	Hours
1	**AI Domains** — Introduction to predictive techniques: classification, regression, and clustering, with hands-on practice applying them to a small dataset using AI tools; Understanding Computer Vision, Natural Language Processing (NLP), and Data Science; Examples like chatbots, image recognition, and translation tools	05
2	**AI in Industries** — Applications in healthcare, education, transport, and communication; How AI improves accuracy, efficiency, and productivity	05
3	**Data Visualisation & Analysis** — Collecting structured data; Creating bar charts, line graphs, or pie charts; Interpreting patterns	05
4	**Ethics & AI Bias Awareness** — Introduction to bias in AI; Case examples; Responsible and fair use of AI; Digital citizenship	05
	Total	**20**

Class 8 — AI Syllabus

#	Content	Hours
1	**AI Project Lifecycle (Conceptual)** — Understanding stages of AI projects: Define Problem, Collect Data, Test AI Tools, Reflect and Improve; How AI learns from patterns in data	05
2	**Deeper Dive into AI Applications** — Exploring AI in the environment, healthcare, automation, and education; Connecting AI systems to real-world problem-solving; Hands-on experience with simple no-code AI tools (image classifiers, chatbots, data prediction apps)	05
3	**Data and Fairness** — Understanding how AI uses data; Identifying bias in datasets; Simple strategies to ensure fairness and inclusivity	05
4	**Ethics and Responsible AI** — Recognising privacy issues, misinformation, and social impact; Responsible use of AI and digital tools; Reflection on real-world challenges	05
	Total	**20**

CENTRAL BOARD OF SECONDARY EDUCATION

Academic Unit, VI Floor, CBSE Integrated Office
Sector 23, Dwarka, New Delhi – 110077