



## Introduction

Computer science education in high school is essential for equipping students with the skills and knowledge necessary to thrive in our technology-dominated world. Firstly, it instills digital literacy, a fundamental skill that enables students to navigate and utilize digital tools effectively. This proficiency is crucial in a society where technology permeates every aspect of life, from communication to professional environments. Moreover, computer science cultivates robust problem-solving skills. By learning to dissect complex issues into manageable parts and develop logical, step-by-step solutions, students gain valuable life skills that extend beyond the classroom. These problem-solving techniques are applicable in various contexts, encouraging a systematic and analytical approach to challenges.

Introducing coding and programming concepts at the high school level provides students with a solid foundation in software development. This early exposure not only demystifies how software works but also fosters creativity and innovation. Students learn to create their own programs and applications, sparking interest in technological exploration and development.

As the job market increasingly demands technological proficiency, early computer science education is critical in preparing students for future careers in STEM fields. The curriculum ensures that students are well-versed in the latest technological trends and tools, giving them a competitive edge in higher education and the workforce.

Beyond technical skills, computer science education highlights interdisciplinary connections. It illustrates the relevance of computational thinking and digital tools to subjects like mathematics, science, and the arts. This holistic approach enhances students' understanding of how computer science intersects with and supports other disciplines, promoting a well-rounded education.

The curriculum also emphasizes the importance of logical thinking, global competence, and ethical technology use. By engaging with these aspects, students develop into responsible digital citizens who understand the implications of their technological interactions. They learn to navigate the digital world ethically and with an awareness of global issues, contributing positively to society.

Diversity and inclusion are key components of computer science education. The curriculum is designed to ensure that students from various backgrounds can engage with and benefit from technology, thereby bridging the digital divide. This inclusive approach fosters a diverse pool of future technologists and innovators.

In essence, computer science education in high school not only imparts practical skills but also nurtures a mindset of curiosity, problem-solving, and creativity. These qualities are invaluable in both academic and professional journeys, setting students on a path to success.

The curriculum also introduces students to several emerging fields in computer science that are shaping the future of technology.

### **Use of Computers in Education**

The use of computers in education has become increasingly prevalent, revolutionizing traditional teaching methods and enhancing the learning experience for students. One primary application is in the realm of digital resources and online learning platforms. Computers enable access to a vast selection of educational materials, from e-books and online articles to interactive simulations and multimedia presentations, fostering a dynamic and engaging learning environment.

Moreover, computers facilitate personalized learning experiences through adaptive learning platforms and intelligent tutoring systems. These systems analyze individual student performance and tailor educational content to meet the specific needs and learning pace of each student, promoting a more effective and personalized learning journey.

Collaborative learning is another area where computers play a crucial role. Virtual classrooms and online collaboration tools enable students to work together on projects, share ideas, and engage in discussions regardless of physical location. This fosters a sense of community and encourages teamwork, skills essential for the collaborative nature of many professional environments.

Furthermore, computers serve as a platform for distance education and online courses, breaking down geographical barriers and providing access to educational resources for individuals who might not have traditional educational opportunities. This is particularly significant in higher education, where online programs allow working professionals to pursue advanced degrees while balancing their professional and personal responsibilities.

The integration of technology in the classroom also enhances teacher effectiveness. Educators can use computers to create multimedia-rich presentations, interactive lessons, and educational games that cater to diverse learning styles. Additionally, computer-based assessment tools streamline the evaluation process, providing immediate feedback to both teachers and students.

## **Rationale for the Review of Curriculum**

After 18<sup>th</sup> amendment in 2010, Sindh was the first province in Pakistan which started developing and reviewing the curriculum. In first phase, curriculum for primary grades was reviewed from 2014 to 2015. In this phase minor changes were made in the National Curriculum 2007. The Computer Education Grade VI- VIII 2007 curriculum was also reviewed during this period and notified with some changes. Based on this review, Sindh Textbook Board developed and printed new textbooks.

On the other hand, National Curriculum Council was established in 2015 at federal level. This council also develop all curricula from ECCE to XII. Sindh showed its reservation about the adoption and implementation of the National Curriculum. Nevertheless, later it was decided that the National Curriculum Standards would be adopted for subjects like Computer Science, Physics, Chemistry and Biology. However, the organizations and content of detailed SLOs (Curriculum Guide) may be modified as per need. Based on this notion, the Directorate of Curriculum, Assessment and Research Sindh started reviewing the curricula to align curriculum with National Curriculum Standards.

This curriculum is based on National Curriculum of Computer Science 2019. However, certain improvement have been brought in this curriculum of Computer Education.

## **Major Changes**

Following major changes were made in the curriculum to adapt the National Curriculum for Computer Science for Grade VI to VIII.

- The Standards and SLOs were reviewed in the Progression Grid and minor changes have been made.
- The Progression Grid and Curriculum Guidelines are merged.
- In the light of allocated periods for Computer Education in Provincial Scheme of Studies, the curriculum has been lightened.
- The SLOs from Curriculum Guideline have been reviewed. As per need SLOs are shuffled, added, modified and deleted while a number of SLOs were clubbed together.
- The sections of Knowledge and Skills in the Curriculum Guide have been merged.
- All SLOs are categorized according to cognitive level.
- The suggested activities and assessments have been reduced in number and simplified as well.

- The domain wise weightage and period allocation have been added.

# Progression Grid - Computer Science & Entrepreneurship

## PART 1: COMPUTER SCIENCE

### Domain A: Computer Systems

**Standard:** *Students will learn about components and interactions between computer systems, stages of software development, data representation and transmission across networks of computing systems, and the implications on usability, reliability, security, etc*

Grade 9	Grade 10	Grade 11	Grade 12
<p><b>Benchmark I:</b> <i>Students will identify and analyze components of computer systems and different levels of interactions between hardware, software, users, and computer networks</i></p>		<p><b>Benchmark I:</b> <i>Students will identify and analyze logic gates in digital systems</i></p> <p><b>Benchmark II:</b> <i>Students will identify stages of system software development</i></p> <p><b>Benchmark III:</b> <i>Students will learn about scalability, reliability, and security of computer networks</i></p>	
Student Learning Outcome			
<p><i>[SLO CS-09-A-01] Students will define and describe types of systems (artificial, natural), computer hardware components such as computer architecture (CPU, microprocessors, etc.),</i></p>	<p><i>[SLO CS-10-A-01] Students will be able to understand and describe number systems and encoding schemes for data representation in computer systems</i></p>	<p><i>[SLO CS-11-A-01] Students will be able to understand and apply logic gates in digital systems, define and create truth tables using Boolean operators like AND, OR, NOT, NAND, XOR) and logic diagrams</i></p>	<p><i>[SLO CS-12-A-01] Students will explain the usability, security and accessibility of devices, the systems they are integrated with.</i></p> <p><i>[SLO CS-12-A-02] Explain human interaction with computer systems in terms of:</i></p> <ul style="list-style-type: none"> <li>- Usability</li> <li>- Common problems</li> <li>- Methods for improvements</li> <li>- Ethical, social, economic, and environmental implications</li> </ul>

<p><i>[SLO CS-09-A-02] Students will be able to identify and explain system software, application software, low-level and high-level programming languages, and their uses.</i></p>	<p><i>[SLO CS-10-A-02] Students will be able to explain how system software controls the flow of information between hardware components used for input, output, storage, and processing</i></p> <p><i>[SLO CS-10-A-03] Students will identify and learn common software tools such as translators, integrated development environments, online and offline computing platforms, code repositories, etc.</i></p>	<p><i>[SLO CS-11-A-02] Students will be able to understand and evaluate stages of the systems design, e.g. software development life cycle (analysis, design, coding, and testing etc.), and software development methodologies</i></p>	
<p><i>[SLO CS-09-A-03] Students will be able to identify and analyze data communication, computer networks, networking devices, basic networking systems and understand how data is transmitted and key concepts such as protocols, speeds, etc.</i></p>		<p><i>[SLO CS-11-A-03] Students will be able to understand and explain the scalability and reliability of networking systems via network topology</i></p> <p><i>[SLO CS-11-A-04] Understand and explain the need for cybersecurity and contrast different methods of encryption to transmit data</i></p>	<p><i>[SLO CS-12-A-03] Identify and explain tradeoffs between the usability and security of computing systems, recommend cybersecurity measures by considering different factors such as efficiency, cost, privacy, and ethics</i></p>

**Domain B: Computational Thinking & Algorithms**

**Standard:** *Students will identify and decompose simple and complex problems, create & evaluate appropriate solutions using computational approaches, and understand and apply common algorithms used in solving computational problems*

Grade 9	Grade 10	Grade 11	Grade 12
<p><b>Benchmark I:</b> <i>Students will understand and apply computational thinking techniques to solve complex, real-world problems.</i></p>		<p><b>Benchmark I:</b> <i>Students have core concepts of basic data structures and algorithms used extensively in computer science and knowledge of how to apply these</i></p>	

	<i>techniques toward solving more complex and real-life problems.</i>		
<b>Student Learning Outcomes</b>			
<i>[SLO CS-09-B-01] Understand and apply techniques to decompose problems</i>	<i>[SLO CS-10-B-01] Students will identify common algorithms used to develop software, store, search, or sort information</i>	<i>[SLO CS-11-B-01] Plan, develop, systematically test, and refine computational artifacts for problem-solving such as pseudocode, etc.</i>	<i>[SLO CS-12-B-01] Understand and evaluate the computational solutions in terms of efficiency, clarity, and correctness</i>
<i>[SLO CS-09-B-02] Solve simple and complex problems computationally</i>	<i>[SLO CS-10-B-02] Develop and apply abstractions to create generalized, modular solutions</i>	<i>[SLO CS-11-B-02] Apply common search, and sort algorithms</i>	<i>[SLO CS-12-B-02] Understand and apply complex algorithms on data structures such as trees and binary search</i>

### Domain C: Programming Fundamentals

**Standard:** Students will create and debug projects in programming languages Python, HTML, and JavaScript, learning how to translate algorithms into code and define & apply fundamental programming constructs such as sequence, selection, and iteration

<b>Grade 9</b>	<b>Grade 10</b>	<b>Grade 11</b>	<b>Grade 12</b>
<b>Benchmark I:</b> <i>Students will develop, test, and debug static website (using HTML and CSS) and a dynamic website (using JavaScript)</i>		<b>Benchmark I:</b> <i>Students will develop, test, debug command-line interface (CLI) applications in Python</i>	
<b>Student Learning Outcomes</b>			
<i>[SLO CS-09-C-01] Students will understand web development and differentiate between a website and a web application</i>	<i>[SLO CS-10-C-01] Students should be able to differentiate between front-end development, and back-end development of a website</i>	<i>[SLO CS-11-C-01] Students should understand the importance of computer programming and applications</i>	<i>[SLO CS-12-C-01] Students should be able to understand and evaluate applications of various programming paradigms.</i>
<i>[SLO CS-09-C-02] Students should be able</i>	<i>[SLO CS-10-C-02] Students should be able</i>	<i>[SLO CS-11-C-02] Students should be able to write and</i>	<i>[SLO CS-12-C-02] Students should be able to</i>

<p>to create a static website using HTML/CSS in an appropriate environment</p> <p>[SLO CS-09-C-03] Students should be able to create dynamic websites using JavaScript as the frontend scripting</p>	<p>to use more advanced HTML/CSS features in an appropriate environment</p> <p>[SLO CS-10-C-03] Students should be able to use more advanced programming constructs (lists, etc.) to create dynamic websites using JavaScript as backend scripting</p>	<p>execute simple programs in Python.</p> <p>[SLO CS-11-C-03] Students should be able to draw shapes using Turtle Graphics functions in Python</p> <p>[SLO CS-11-C-04] Students should be able to understand the need for libraries and learn the use of some simple libraries in Python.</p>	<p>use more advanced programming constructs such as data structures (lists etc.), file handling (disk IO to write to storage), and databases in Python.</p>
<p>[SLO CS-09-C-04] Students should be able to implement common algorithms that use sequence, selection, and repetition in JavaScript</p>	<p>[SLO CS-10-C-04] Students should be able to implement complex algorithms that use more complex data structures (lists, etc.) in JavaScript</p>	<p>[SLO CS-11-C-05] Students should be able to translate simple algorithms that use sequence and repetition in Python.</p> <p>[SLO CS-11-C-06] Students should be able to decompose a problem into sub-problems and implement those sub-problems using functions in Python.</p>	<p>[SLO CS-12-C-04] Students should be able to implement complex algorithms that use lists etc. in Python</p>
<p>[SLO CS-09-C-05] Students will determine ways of debugging their code in JavaScript</p>	<p>[SLO CS-10-C-05] Students will determine more advanced techniques (unit tests, breakpoints, watches) for testing and debugging their code in JavaScript</p>	<p>[SLO CS-11-C-07] Students will determine ways of debugging their code in Python</p>	<p>[SLO CS-12-C-05] Students will determine more advanced techniques (unit tests, breakpoints, watches) for testing and debugging their code in Python</p>

## Domain D: Data Analysis

**Standard 1:** Students will be able to understand the scope of data science, how computer systems collect, store, process, visualize, and interpret data

**Standard 2:** Students will get an introduction to the relational data model, relational database engines, and SQL and how to design good schemas.

**Standard 3:** What is AI and machine learning, and how does it relate to data and data science

Grade 9	Grade 10	Grade 11	Grade 12
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<b>Benchmark I:</b> Students will be able to define and explain how to collect, store, analyze, visualize data		<b>Benchmark I:</b> Students will be able to represent databases using UML diagrams and extract data using queries, and create data visualizations using software tools	
Student Learning Outcomes			
[SLO CS-09-D-01] Students will explain the scope of the data science field as an interdisciplinary field (computer sciences, mathematics & statistics, and business knowledge & understanding).	[SLO CS-10-D-01] Students will understand and explain the scope of data science, Artificial Intelligence (AI), and Machine Learning (ML), including types of supervised and unsupervised learning models, and their applications to common real-world problems.	[SLO CS-11-D-01] Students will be able to relate the role and importance of model building with their real-world applications  [SLO CS-11-D-02] Students will understand and explain experimental design in data science	[SLO CS-12-D-01] Students will be able to analyse data and identify key model performance metrics of real-world machine learning models.
[SLO CS-09-D-02] Students will define and explain data types, data collection, and data storage.	[SLO CS-10-D-02] Students will understand and explain the types, uses, and methods of data visualizations and understand the benefits of visualizing data	[SLO CS-11-D-03] Students will analyze pre-existing datasets to create summary statistics and data visuals (such as bar charts, pie charts, line graphs, etc.)	[SLO CS-12-D-02] Students will explain and create a data visualization using Structured Query Language (SQL), or Python, or R
[SLO CS-09-D-03] Students will be able to define and explain big data, and applications of big data in real-world business	[SLO CS-10-D-03] Students will be able to apply stages of the data science life cycle e.g. understanding a real-world business problem, data gathering, building model, interpreting results).		Advanced SLO  [SLO CS-12-D-03] Students will learn how to form hypotheses and perform hypothesis testing.  Students will learn to communicate findings using advanced data visuals and tie them back to hypotheses.

### Domain E: Applications of Computer Science

**Standard 1:** Students will understand computer technologies such as Blockchain / AI / IoT / Cloud Computing / Game design and development

**Standard 2:** Students should be able to understand how computers learn, make decisions, and the applications, challenges, and social implications of AI

Grade 9	Grade 10	Grade 11	Grade 12
<b>Benchmark I:</b> Students learn about different popular fields in Computer Science like AI, Cloud Computing, IoT, and Blockchain.		<b>Benchmark I:</b> Students learn about different technologies that support the latest applications of CS and their relevance to Pakistan.	

		<b>Benchmark II:</b> Students learn about data techniques in AI applications and the social implications of technology.	
<b>Student Learning Outcome</b>			
<i>[SLO CS-09-E-01] Students will be able to describe uses and applications of computing like AI, Machine Learning, and Cloud Computing</i>	<i>[SLO CS-10-E-01] Students will be able to describe uses and applications that are enabled by technologies like IoT, and Blockchain</i>	<i>[SLO CS-11-E-01] Students should be able to describe technologies that are the foundations of IoT systems, Cloud Computing, and Blockchain</i>	<i>[SLO CS-12-E-01] Students should be able to design ideas of applications relevant to Pakistan using IoT, Cloud computing, and Blockchain</i>
	<i>[SLO CS-10-E-02] Students will be able to explain that AI can be applied to specific applications in areas like NLP, Robotics, Speech Recognition, etc.</i>		<i>[SLO CS-12-E-02] Students should be able to describe deep learning and its applications</i>
<i>[SLO CS-09-E-02] Students will be able to discuss the social implication of the usage of AI in decision-making that affects humans</i>	<i>[SLO CS-10-E-03] Students will be able to demonstrate the social implications of AI</i>	<i>[SLO CS-11-E-02] Students should be able to evaluate how different stakeholder's culture, values, and (sometimes conflicting) interests affect AI System designs.</i>	<i>[SLO CS-12-E-03] Students should be able to assess policies that can help protect different stakeholders' interests</i>  <i>[SLO CS-12-E-04] Students should be able to evaluate scenarios with data sharing and privacy conflicts and suggest policy decisions that can help achieve acceptable compromises.</i>

## Domain F: Impacts of Computing

**Standard:** Students will be able to understand ethics and laws related to computing and the use of computing devices, media, data, the internet, and the application of personal privacy and network security.

**Standard 2:** The environmental, cultural, and human impact of computing and assistive technologies to the modern world.

Grade 9	Grade 10	Grade 11	Grade 12
<p><b>Benchmark I:</b> Students will obtain knowledge of ethical and legal issues surrounding the use of computing.</p> <p><b>Benchmark II:</b> Students will understand privacy and network security issues surrounding computing applications and devices they use everyday</p> <p><b>Benchmark III:</b> Students will understand the role of assistive technologies and understand the implications of the digital divide</p>		<p><b>Benchmark I:</b> Students will interpret documents related to computing systems and evaluate their legal and ethical implications.</p> <p><b>Benchmark II:</b> Students will be able to illustrate how they can maintain privacy online and address security concerns they may encounter with the use of computing devices and applications</p> <p><b>Benchmark III:</b> Students will demonstrate their ability to collaborate and communicate on the design of computing applications</p>	
Student Learning Outcomes			
<p>[SLO CS-09-F-01] Understand and apply safe and responsible use of computers (responsible use of hardware, appropriate use of software, and safe use of digital platforms like data searches, social networking, etc.)</p>	<p>[SLO CS-10-F-01] Understand and apply safe &amp; responsible use of the internet to prevent addiction, promote information and data security</p>	<p>[SLO CS-11-F-01] Understand and apply safe &amp; responsible use of information sources, identifying sources of reliable information compared to unreliable information and its sources</p>	<p>[SLO CS-12-F-01] Identify and apply safe practices when collaborating on digital or online platforms.</p>
<p>[SLO CS-09-F-02] Analyze the beneficial and harmful effects of computing innovations such as social networking, fake news, etc.</p>	<p>[SLO CS-10-F-02] Evaluate the impact of and apply strategies to prevent cyberbullying/harassment</p>		<p>[SLO CS-12-F-02] Discuss security threats and mitigation such as 2FA, biometric verification, and secure techniques for transmitting data etc.</p>
<p>[SLO CS-09-F-03] Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices</p>	<p>[SLO CS-10-F-03] Analyze the impacts of the digital divide on access to critical information</p>	<p>[SLO CS-11-F-02] Define and discuss how computing has increased connectivity by enabling communication between people and the environmental, cultural, and human impact of</p>	<p>[SLO CS-12-F-03] Collaborate on strategies to provide equity and equal access to information</p>

		<i>increased connectivity</i>	
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**Domain G: Digital Literacy**

**Standard:** Collect & analyze information and publish to various audiences using digital tools and media-rich resources, and use digital tools to design and develop a significant digital artefact through research design, data collection, and communication.

Grade 9	Grade 10	Grade 11	Grade 12
<b>Benchmark I:</b> <i>Collect &amp; analyze information and publish to various audiences using digital tools and media-rich resources.</i>		<b>Benchmark I:</b> <i>Use digital tools to design and develop a significant digital artefact through research design, data collection, and communication.</i>	
Student Learning Outcomes			
	<i>[SLO CS-10-G-01] Communicate and publish key ideas and details to a variety of audiences using appropriate digital tools and media-rich resources</i>	<i>[SLO CS-11-G-01] Perform advanced searches to locate information and/or design a data-collection approach to gather original data (e.g., qualitative interviews, surveys, prototypes, simulations)</i>	<i>[SLO CS-12-G-01] Students will create an artifact that answers a research question, communicates results and conclusions through digital resources or tools</i>

**PART 2: ENTREPRENEURSHIP IN THE DIGITAL AGE**

**Domain H: Entrepreneurship in the Digital Age**

**Standard:** Students will create a business using design thinking with the help of digital tools

Grade 9	Grade 10	Grade 11	Grade 12
<b>Benchmark:</b> Students will learn how to identify problems and create and present business solutions		<b>Benchmark:</b> Students will learn how to build successful products or services by creating and testing prototype and launching a minimum viable product	
Student Learning Outcomes			

<p><i>[SLO EN-09-H-01]: Students identify a problem and create a business idea using design thinking</i></p>	<p><i>[SLO EN-10-H-01]: Students will use digital tools to conduct research to collect market and customer insights for a business idea</i></p>	<p><i>[SLO EN-11-H-01]: Students will create, test, and iterate a prototype for a business idea</i></p>	<p><i>[SLO EN-12-H-01]: Students will create and test a minimum viable product for their business</i></p>
<p><i>[SLO EN-09-H-02]: Students will use digital tools to create and present a business plan</i></p>	<p><i>[SLO EN-10-H-02]: Students will pitch a business idea</i></p>		

# Grade IX

## DOMAIN A: Computer Systems

[SLO CS-09-A-01] Students will define and describe types of systems (artificial, natural), computer hardware components such as computer architecture (CPU, microprocessors, etc.)

Theme	Detailed SLOs	Cognitive Level
<p>Fundamentals of Systems and their types</p> <p>Core Components of Computers</p> <p>Functions of computer system</p> <p>Data Transfer within Computer</p> <p>Types and Hierarchy of computer memory</p> <p>History of Computer</p>	<p><b>Students will able to:</b></p> <ul style="list-style-type: none"> <li>• Define basic concepts of a system, types of systems i.e. natural and artificial systems</li> <li>• Differentiate between natural and artificial systems</li> <li>• Identify the core components of a computer (input/output devices, system unit (motherboard, memory, CPU, power supply, etc.), and data storage devices</li> <li>• Differentiate between hardware engineering and software engineering</li> <li>• Explain key functions of computer components such as central processing unit (CPU), arithmetic logic unit (ALU), control unit (CU), memory, operating and application software</li> <li>• Describe the computer architecture</li> <li>• Explain data measuring units in computers (bit, byte, Kilo Byte, Mega Byte, Giga Byte, and Tera Byte)</li> <li>• Discuss how data is transferred within a computer system; including communication between components like CPU, memory and peripherals.</li> <li>• Differentiate memory types (primary, secondary, auxiliary and cache) with respect to their volatility/ retention, speed, storage capacity, cost</li> <li>• Differentiate between necessary and auxiliary components of a computer system</li> <li>• Discuss brief history of computer systems and generation of computers</li> </ul>	<p>K</p> <p>U</p> <p>K</p> <p>U</p> <p>U</p> <p>U</p> <p>U</p> <p>U</p> <p>U</p> <p>U</p> <p>U</p>
<p>[SLO CS-09-A-02] Students will be able to identify and explain system software, application software, low-level and high-level programming languages and their uses</p>		
	<p><b>Students will able to:</b></p>	

<p>Computer Software</p> <p>Choosing the Right Digital Tool</p>	<ul style="list-style-type: none"> <li>• Describe the main functions of system and application software and their types.</li> <li>• Relate the uses of various application software to daily life.</li> <li>• Choose an appropriate medium to create artifacts (Planning the document / information flow, editing and alignment of page, paragraphs, text, tables, and graphics) to communicate ideas in various digital tools such as: <ul style="list-style-type: none"> <li>○ Image processing tools (like Photoshop, Canva.com, GIMP etc.)</li> <li>○ Word processors (like MS Word, Google Docs etc.)</li> <li>○ Presentations (like MS PowerPoint or Google Slides etc.)</li> <li>○ Spreadsheets (like MS Excel or Google Sheets)</li> </ul> </li> </ul>	<p>U</p> <p>U</p> <p>A</p>
<p>Programming languages</p>	<ul style="list-style-type: none"> <li>• Define programming languages and their types</li> <li>• Differentiate between low level and high-level programming languages.</li> </ul>	<p>K</p> <p>U</p>
<p>[SLO CS-09-A-03] Students will be able to identify and analyze data communication, computer networks, networking devices, basic networking systems and understand how data is transmitted and key concepts such as protocols, speeds, etc.</p>		
<p><b>Theme</b></p>	<p><b>Detailed SLOs</b></p>	<p><b>Cognitive Level</b></p>
<p>Network Devices</p> <p>Network Basics</p>	<p><i>Students will be able to:</i></p> <ul style="list-style-type: none"> <li>• Explain the data communication components (sender, receiver, message, protocols, transmission medium)</li> <li>• Describe the following networking devices <ul style="list-style-type: none"> <li>○ <i>Hub</i></li> <li>○ <i>Bridge</i></li> <li>○ <i>Switch</i></li> <li>○ <i>Router</i></li> </ul> </li> <li>• Differentiate between network and networking</li> <li>• Define the network protocols (TCP/ IP, DNS, UDP, FTP, HTTP)</li> <li>• State network topologies and transmission modes</li> <li>• Compare the advantages and disadvantages of wired and wireless networks.</li> <li>• Describe common applications of the Internet</li> <li>• Compare the data transmission speed (Mbps, Gbps, etc)</li> </ul>	<p>U</p> <p>U</p> <p>U</p> <p>K</p> <p>U</p> <p>U</p> <p>U</p> <p>U</p>

**DOMAIN B: Computational Thinking & Algorithm**

[SLO CS-09-B-01] Understand and apply techniques to decompose problem		
Theme	Detailed SLOs	Cognitive Level
Problem Decomposing Techniques	<p>Student will be able to:</p> <ul style="list-style-type: none"> <li>• Describe the principle of Computational Thinking (Decomposition, pattern recognition, abstraction and Algorithm).</li> <li>• Discuss computational thinking and Problem solving.</li> <li>• Differentiate the two Principles of computational thinking:                             <ul style="list-style-type: none"> <li>○ Logical</li> <li>○ Algorithmic</li> </ul> </li> <li>• Apply principles to define and refine a problem by considering:                             <ul style="list-style-type: none"> <li>○ Inputs</li> <li>○ Processes</li> <li>○ Outputs</li> </ul> </li> </ul>	<p>U</p> <p>U</p> <p>U</p> <p>A</p>
[SLO CS-09-B-02] Solve simple and complex problems computationally		
Solving a Simple and Complex Problems	<p>Student will be able to:</p> <ul style="list-style-type: none"> <li>• Differentiate Simple and Complex problem.</li> <li>• Design solutions for <i>simple problem</i> thorough flowchart, and/or concept maps For example:                             <ul style="list-style-type: none"> <li>○ Design a mark sheet of students: Calculate total and percentage</li> </ul> </li> <li>• Design solutions for <i>complex problem</i> by decomposing it into parts, draw a flowchart to understand a structure of problem For example:                             <ul style="list-style-type: none"> <li>○ Obtaining a grade of above given example of simple problem</li> <li>○ Calculate net salary of an employee (Note: Net salary = basic salary + Allowance – Tax)</li> </ul> </li> <li>• Identify subsections of the problem and their connections to other parts.</li> </ul>	<p>U</p> <p>A</p> <p>A</p> <p>U</p>

**Domain C: Programming Fundamentals**

[SLO CS-09-C-01] Students will understand web development and differentiate between a website and a web application		
Theme	Detailed SLOs	Cognitive Level
	<p>Students will be able to:</p> <ul style="list-style-type: none"> <li>•</li> </ul>	<p>U</p>

<p>Web sites &amp; Web Applications</p>	<ul style="list-style-type: none"> <li>• Describe the basic concepts and principles of web development, including the technologies, languages, and frameworks commonly used in building websites and web applications.</li> <li>• Differentiate front- end and back- end development</li> <li>• Identify and describe the features and characteristics of a website (static content, informational pages, navigation menus, multimedia elements, and contact forms).</li> <li>• Understand the distinctive features of web applications as they offer more complex functionality (such as user input, data manipulation, and task execution. They are dynamic in nature, offering interactive functionalities, user authentication, and real-time updates).</li> <li>• Distinguish between websites and web applications based on specific criteria.</li> </ul>	<p>U</p> <p>U K</p> <p>U</p> <p>U</p>
<p>[SLO CS-09-C-02] Students should be able to create a static website using HTML/CSS in an appropriate environment</p>		
Theme	Detailed SLOs	Cognitive Level
<p>HTML, CSS &amp; Java Script</p> <p>Static &amp; Dynamic Web pages</p>	<p>Students will be able to:</p> <ul style="list-style-type: none"> <li>• Describe <ul style="list-style-type: none"> <li>○ HTML</li> <li>○ CSS</li> <li>○ JavaScript</li> </ul> </li> <li>• Explain the elements used in HTML (Text Formatting, Hyperlinks, <a href="#">Media</a>, Lists etc.)</li> <li>• Differentiate static &amp; dynamic web pages and determine which technology is appropriate for making static and dynamic websites</li> <li>• Understand how java script is used to modify a website</li> <li>• Create a static website using HTML &amp; CSS in an IDE like Visual Studio, NetBeans etc.</li> </ul>	<p>K</p> <p>U</p> <p>U</p> <p>U</p> <p>A</p>
<p>[SLO CS-09-C-03] Students should be able to create dynamic websites using JavaScript as the front- end scripting</p>		
Theme	Detailed SLOs	Cognitive Level
<p>Variables, Data types</p>	<p>Students will be able to: Define Variables and their data types</p>	<p>K</p>

Java Script with HTML and CSS	<ul style="list-style-type: none"> <li>• Discuss the applications of JavaScript</li> <li>• Take input in JavaScript and assign value to variable</li> <li>• Use JavaScript to modify a static web site (HTML and CSS based) to change into a dynamic website</li> <li>• Define Document Object Model</li> <li>• Use Document Object Model in a website</li> </ul>	U A A K A
[SLO CS-09-C-04] Students should be able to implement common algorithms that use sequence, selection, and repetition in JavaScript		
<b>Theme</b>	<b>Detailed SLOs</b>	<b>Cognitive Level</b>
Using Algorithm	<i>Students will be able to:</i> <ul style="list-style-type: none"> <li>• Apply simple algorithms to write programs</li> <li>• Explain conditions and loops in JavaScript and their effects on the result</li> <li>• Use conditional statements to make decisions and control the flow of execution in JavaScript programs.</li> <li>• Write loops to repeatedly execute a block of code based on specified conditions.</li> <li>• Discuss the concept of Nested Loops</li> </ul>	A U A A U
Arrays in Java script	Explain an array Construct an array and manipulate its values using loop in JavaScript.	U A
[SLO CS-09-C-05] Students will describe functions and their uses and determine ways of debugging their code in JavaScript		
<b>Theme</b>	<b>Detailed SLOs</b>	<b>Cognitive Level</b>
Functions in JavaScript	<i>Students will be able to:</i> <ul style="list-style-type: none"> <li>• Explain functions and its structure</li> <li>• Differentiate types of functions (system defined and user defined)</li> <li>• Create a function to manipulate values</li> <li>• Discuss the process of passing arguments and returning value from function</li> </ul>	U U A U
Debugging using function & using breakpoints	<ul style="list-style-type: none"> <li>• Identify different types of errors</li> <li>• Discuss debugging</li> <li>• Use functions for debugging</li> <li>• Define breakpoints and console logs</li> <li>• Debug a program</li> </ul>	K U A K A

**Domain D: Data and Analysis**

[SLO CS-09-D-01] Students will explain the scope of the data science field as an interdisciplinary field (computer sciences, mathematics & statistics, and business knowledge & understanding).		
Theme	Detailed SLO's	Cognitive Level
Introduction of Data science	Students will be able to: <ul style="list-style-type: none"> <li>Describe the key concepts and principles of data science</li> </ul>	U
Scope of Data Science	<ul style="list-style-type: none"> <li>Explain the scope of the data science interdisciplinary field computer science, mathematics, statistics, and business knowledge</li> <li>Differentiate between data science and data analytics,</li> </ul>	U
		U
Analytical Thinking Development	<ul style="list-style-type: none"> <li>Develop analytical thinking skills by reading case studies on data science applications</li> </ul>	A
[SLO CS-09-D-02] Students will define and explain data types, data collection, and data storage.		
Theme	Detailed SLO's	Cognitive Level
Exploring the Key Concepts & Datasets	Students will be able to: <ul style="list-style-type: none"> <li>Differentiate between data and dataset</li> <li>Discuss the concept of data as a fundamental unit of Information that conveys meaning and significance</li> <li>Discuss data as observations or measurements represented in various formats, including numbers, text, images, sound, video, etc.</li> <li>Describe dataset is a collection of this data that is related in some context, different sources of data like sensors.</li> <li>Explain missing data in a dataset</li> </ul>	U
		U
		U
		U
		U
Relational Data Model and Datasets	<ul style="list-style-type: none"> <li>Differences between structured and unstructured data, quantitative and qualitative data.</li> <li>Determine the concept of dataset in terms of Object Rational Model <ul style="list-style-type: none"> <li>Table (relation)</li> <li>Rows (record, tuple, object)</li> <li>Column (object attributes, properties)</li> </ul> </li> </ul>	U
		U

Information handling and Data Collection methods	<ul style="list-style-type: none"> <li>• Explain data, information, and knowledge as represented for computational tasks</li> </ul>	U
	<ul style="list-style-type: none"> <li>• Create summary statements about the data, how it is collected, how it is used, and how to work with it.</li> </ul>	A
	<ul style="list-style-type: none"> <li>• Develop and interpret a frequency table.</li> </ul>	A
	<ul style="list-style-type: none"> <li>• Collect, upload, and share personal data collected in class (e.g., Stick Figure exercise in Learning Activity # 2)</li> </ul>	A
	<ul style="list-style-type: none"> <li>• Discuss about different representations of distributions using software.</li> </ul>	U
	<ul style="list-style-type: none"> <li>• Apply software to begin to analyze plots of data collected (MS. EXCEL/ACCESS/ MS.Power BI /Rstudio/ Online Colab).</li> </ul>	A
	<ul style="list-style-type: none"> <li>• Interpret different types of data: Numerical and graphical summaries.</li> </ul>	U
	<ul style="list-style-type: none"> <li>• Understand that rows and columns are a form of data structure.</li> </ul>	U

*[SLO CS-09-D-03] Students will be able to define and explain big data, and applications of big data in real-world business*

Big Data & Analytics	<p>Students will be able to:</p> <ul style="list-style-type: none"> <li>• Discuss big data analytics for businesses</li> <li>• Discuss tools and systems used by big data scientists and engineers</li> <li>• Recognize the applications of big data</li> <li>• Discuss, what makes big data valuable</li> <li>• Distinguish between Data Science and Big Data</li> <li>• Discuss predictive modeling and graph analytics can be used to solve real-world problems.</li> </ul>	U U U U U
Implication of Big Data	<ul style="list-style-type: none"> <li>• Recognize when big data is used to solve a business problem.</li> <li>• Read and critique published stories/ case studies by interpreting the visualizations and experimental conclusions</li> <li>• Compare new business solutions using big data with traditional methods.</li> </ul>	U A U

**Domain E: Applications of Computer Science**

*[SLO CS-09-E-01] Students will be able to describe uses and applications of computing like AI, Machine Learning, and Cloud Computing*

Theme	Detailed SLOs	Cognitive Level
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Applications of Computer Science	Students will be able to:	U
	<ul style="list-style-type: none"> <li>Describe what is AI and Machine learning and the kind of problems each is able to solve</li> </ul>	U
	<ul style="list-style-type: none"> <li>Discuss different areas of AI – Speech Recognition, Computer Vision, Natural Language Processing, and Expert Systems.</li> </ul>	U
	<ul style="list-style-type: none"> <li>Relate applications of AI in real- world domains like healthcare, education, gaming, agriculture.</li> </ul>	U
Implication of AI In Computer Science Application	<ul style="list-style-type: none"> <li>Explain cloud computing and its need</li> </ul>	U
	<ul style="list-style-type: none"> <li>Analyze the advantages and limitations of using AI, Machine Learning, and Cloud Computing in different contexts.</li> </ul>	U
	<ul style="list-style-type: none"> <li>Identify problem areas (domains) that can be solved using these technologies</li> </ul>	U
[SLO CS-09-E-02] Students will be able to discuss the social implication of the usage of AI in decision-making that affects humans		
Theme	Detailed SLOs	Cognitive Level
Social Implication & AI in decision-making	Students will be able to: <ul style="list-style-type: none"> <li>Discuss how AI algorithm design should benefit people.</li> <li>Evaluate that AI algorithms make decisions that work for most people but harm or disadvantage others.</li> </ul>	U U
Ethical Impacts of AI, Machine Learning and Cloud Computing	<ul style="list-style-type: none"> <li>Evaluate the ethical implications of implementing AI, Machine Learning, and Cloud Computing solutions.</li> <li>Identify AI based decisions that might harm humanity and/ or environment</li> <li>Explain what are some ethical issues when computers make decisions for humans for example: automated systems</li> <li>Identify decisions that might be biased toward certain groups of people.</li> </ul>	U U K K

**Domain F: Impacts of Computing**

[SLO CS-09-F-01] <i>Understand and apply safe and responsible use of computers (responsible use of hardware, appropriate use of software, and safe use of digital platforms like data searches, social networking, etc.).</i>		
Theme	Detailed SLO's	Cognitive Level
Introduction of Data science	Students will be able to: <ul style="list-style-type: none"> <li>Describe the key concepts and principles of data science</li> </ul>	U
[SLO CS-09-F-02] <i>Analyze the beneficial and harmful effects of computing innovations such as social networking, fake news, etc.</i>		

Theme	Detailed SLOs	Cognitive Level
Impacts of Computing Innovation	<p><i>Students will be able to:</i></p> <ul style="list-style-type: none"> <li>• Discuss every computing innovation will solve a need but can cause harm to users as well</li> <li>• Benefits such as needs for society and individuals</li> <li>• Harmful effects of computing innovations on users, society, environment, etc.</li> <li>• Define tradeoffs between information privacy, system security and usability</li> <li>• Discuss importance of designing computing systems that will protect user privacy and increase system security</li> </ul>	U U U K K
Cyber safety and crimes	<ul style="list-style-type: none"> <li>• Describe &amp; differentiate key concepts: scams, software piracy, freeware, shareware, opensource, malware, phishing, hacking</li> <li>• Understand trade-off between censorship of internet and freedom of speech</li> <li>• Define types of security problems such as spam, spyware, pharming, cookies etc.</li> </ul>	K U K
Reliable Digital Sources	<ul style="list-style-type: none"> <li>• Explain basics of reliable and unreliable sources of information</li> <li>• Distinguish between fake news and credible sources of information</li> <li>• Identify malicious internet scams, phishing, pharming, fraudulent activity, fake websites,</li> <li>• Discuss designs of computing technologies (e.g. social media, generative AI etc.) based on their user privacy policies and agreements</li> </ul>	K U U U
[SLO CS-09-F-03] <i>Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices</i>		
Theme	Detailed SLOs	Cognitive Level
Environmental Impacts of Computing	<p><i>Students will be able to:</i></p> <ul style="list-style-type: none"> <li>• Explain environmental impacts of computing</li> <li>• Discuss impacts of computing over our lifestyle and businesses</li> <li>• Describe impact of computing on globalization and e-commerce</li> <li>• Define key terms: patents, trademarks, copyrights</li> </ul>	U U U K
Remedies to Computing Hazards	<ul style="list-style-type: none"> <li>• Strategize on how to minimize the environmental impacts of computing</li> <li>• Search and identify patents, trademarks and copyright information for computing applications</li> <li>• Determine if technology design damages intellectual property</li> </ul>	U U A

	<ul style="list-style-type: none"> <li>Evaluate designs of computing technologies in terms of personal, environmental, ethical, legal, social, economic, and cultural impacts</li> </ul>	K
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Note: Domain G: Digital Literacy starts from Grade X

**Domain H: Entrepreneurship in the Digital Age**

[SLO CS-09-H-01] Students identify a problem and create a business solution using design thinking		
Theme	Detailed SLOs	Cognitive Level
Introduction & Scope of Entrepreneurship	<ul style="list-style-type: none"> <li>Discuss an entrepreneurial solution to address a local or global problem</li> <li>Define Sustainable Development Goals (SDGs) as the world’s development goals, and linking these SDGs to potential problems that need resolving</li> <li>Differentiate between Growth mindset vs. fixed mindset</li> <li>Use design thinking to create a solution for a certain problems</li> </ul>	U
		K
Problem Solving Skills	<ul style="list-style-type: none"> <li>Discuss skills needed for problem solving: 4Cs of the 21<sup>st</sup> century (<i>collaboration, critical thinking, creativity, communication</i>)</li> <li>Define “<i>design thinking</i>” as a process which includes:               <ul style="list-style-type: none"> <li>Empathizing to discover the problem</li> <li>Defining or interpreting the problem</li> <li>Conceiving how to solve the problem</li> <li>Experimenting or prototyping the solution</li> <li>Evolving the solution as insights redefine the problem</li> </ul> </li> </ul>	U
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		K

[SLO CS-09-H-02] Students will use digital tools to create and present a business plan for an entrepreneurial solution.		
Theme	Detailed SLOs	Cognitive Level
Marketplace & Business Plan Development	<ul style="list-style-type: none"> <li>Discuss key elements of a business plan</li> <li>Describe how to collect &amp; synthesize information to create a business plan</li> <li>Create a business plan using digital tools like MS Word or Google Docs to communicate business problem, suggested solution, and financial feasibility</li> <li>Evaluate a business plan using criteria such as communication, feasibility, market potential etc.</li> </ul>	U
		U
		A
		U

## Grade X

### **DOMAIN A: Computer Systems**

[SLO CS-10-A-01] Students will be able to understand and describe number systems and encoding schemes for data representation in computer systems

Theme	Detailed SLOs	Cognitive Level
Data representation	<p><b>Students will be able to:</b></p> <ul style="list-style-type: none"> <li>Describe machine level representation of data</li> <li>Explain different numbering systems (decimal, binary, octal, hexadecimal)</li> </ul>	U U
Text Encoding and Representation	<ul style="list-style-type: none"> <li>Define Key terms: ASCII, Unicode, binary, signed and unsigned numbers, bit, byte</li> <li>Discuss how text is represented digitally using common text encoding (ASCII, Unicode)</li> <li>Explain how binary calculation or basic operation works in computer such as addition, subtraction, multiplication and division, negatives in binary, 1's complement, 2's complement, binary arithmetic, overflow and underflow.</li> </ul>	K U U

[SLO CS-10-A-02] Students will be able to explain how system software controls the flow of information between hardware components used for input, output, storage, and processing.

Theme	Detailed SLOs	Cognitive Level
Understanding Operating Systems	<p>Students will be able to:</p> <ul style="list-style-type: none"> <li>Describe an operating system, its types and user interfaces</li> <li>Explain main tasks performed by operating systems</li> </ul>	U U
Key Concepts in Operating Systems	<ul style="list-style-type: none"> <li>Define key terms: System calls, Processes, Threads, Synchronization, Interrupts, System Calls Scheduling, Deadlock, File System Interface, Memory System and virtual memory</li> </ul>	K
Operating System Resources and Services	<ul style="list-style-type: none"> <li>Define primary resources managed by an operating system such as:               <ul style="list-style-type: none"> <li>RAM</li> <li>CPU</li> <li>File System</li> <li>Network Connection</li> </ul> </li> <li>Explain services provided by operating system.</li> </ul>	K U

Process Management and Execution	<ul style="list-style-type: none"> <li>• Discuss processes and their lifecycle</li> <li>• Define Process Synchronization and scheduling</li> </ul>	U K
Memory Management in Operating Systems	<ul style="list-style-type: none"> <li>• Differentiate approaches to Memory Management</li> <li>• Define structure and organization of the file system.</li> </ul>	U K
[SLO CS-10-A-03] Students will identify and learn common software tools such as translators, integrated development environments, online and offline computing platforms, code repositories, etc.		
Understanding Software Types and Hosting	<p>Students will be able to ...</p> <ul style="list-style-type: none"> <li>• Differentiate types of software (online / off-line)</li> <li>• Define software hosting modes (on-premise vs. in cloud) and their pros and cons</li> </ul>	U K
Programming Software and its uses	<ul style="list-style-type: none"> <li>• Demonstrate Integrated Development Environment (IDE) and its uses.</li> <li>• Define Productivity applications and give the names of most common software that are used in real world.</li> <li>• Describe uses of programming software such as language editors, debuggers, compilers, IDEs, source code repositories and build systems (e.g. Eclipse for Java, Coda for Mac, Visual Studio for multiple languages, GitHub for source code)</li> </ul>	A K
Programming Software Tools	<ul style="list-style-type: none"> <li>• Define the key software tools such as translators, online and offline computing platforms, code repositories etc.</li> </ul>	U  K

### **DOMAIN B: Computational Thinking & Algorithm**

[SLO CS-10-B-01] Students will identify common algorithms used to solve problems and apply algorithms to store, search, or sort information		
Theme	Detailed SLOs	Cognitive Level
Counting Problems and its principles	<p><i>Student will be able to:</i></p> <ul style="list-style-type: none"> <li>• Define simple and complex problem</li> </ul>	K
Algorithm and properties	<ul style="list-style-type: none"> <li>• Explain Properties of Algorithm <ul style="list-style-type: none"> <li>○ Input</li> </ul> </li> </ul>	K



	<ul style="list-style-type: none"> <li>Apply abstraction technique to make a building by using set of blocks</li> </ul>	
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**DOMAIN C: Programming Fundamentals**

[SLO CS-10-C-01] Students should be able to differentiate between front-end development, and back-end development of a website		
Theme	Detailed SLOs	Cognitive Level
Back-end and front-end development	Students will be able to <ul style="list-style-type: none"> <li>Discuss the application of back-end and front-end development</li> <li>Identify different technologies for back- end and front-end development.</li> </ul>	U K
[SLO CS-10-C-02] Students should be able to use more advanced HTML/ CSS features in an appropriate environment		
Forms, Inputs, Tables and Animations using applications	Students will be able to <ul style="list-style-type: none"> <li>Use appropriate HTML tags to show tabular data</li> <li>Create tables in HTML using an IDE like Visual Studio, Netbeans etc.</li> <li>Create forms in HTML using an IDE like Sublime, Visual Studio, Netbeans etc.</li> <li>Write code in HTML to take inputs from users in different format</li> <li>Apply animation movements to HTML components and animation in CSS (using Visual Studio, Netbeans)</li> </ul>	A A A A A
[SLO CS-10-C-03] Students should be able to use more advanced programming constructs (lists, etc.) to create dynamic websites using JavaScript as back- end scripting		
Arrays in Java script	Students will be able to <ul style="list-style-type: none"> <li>Create and use bullet points (lists) in HTML</li> <li>Create bullet points in HTML that are generated from an array in JavaScript</li> <li>Create a dynamic website</li> </ul>	A A A
[SLO CS-10-C-04] Students should be able to implement complex algorithms that use more complex data structures (lists, etc.) in JavaScript		
Searching Array algorithm in Javascript using loops	Students will be able to: <ul style="list-style-type: none"> <li>Write an algorithm that finds an element in a list and array</li> <li>Sort any number of strings using Bubble Sort method</li> <li>Display all possible combinations of a given string in an array</li> </ul>	A A A

[SLO CS-10-C-05] Students will determine more advanced techniques (unit tests, breakpoints, watches) for testing and debugging their code in JavaScript		
Unit test, break points, watches for Debugging	Students will be able to <ul style="list-style-type: none"> <li>• Discuss debugging and testing (unit tests, breakpoints, watches)</li> <li>• Debug a program code</li> <li>• Apply breakpoints to analyze values of variables in JavaScript</li> </ul>	U A A

### DOMAIN D: Data and Analysis

[SLO CS-10-D-01] Students will understand and explain the scope of data science, Artificial Intelligence (AI), and Machine Learning (ML), including types of supervised and unsupervised learning models, and their applications to common real-world problems.		
Theme	Detailed SLOs	Cognitive Level
Artificial Intelligence and Machine learning	<b>Students will be able to:</b> <ul style="list-style-type: none"> <li>• Discuss the Data Science lifecycle: Collecting, processing, analyzing, visualizing and understanding model outcomes (predictions / descriptive).</li> <li>• Discuss the overlapping areas of data science, AI and ML</li> <li>• Recognize the Artificial intelligence skills include:               <ul style="list-style-type: none"> <li>○ Machines emulation/ Simulation of human behavior.</li> <li>○ Natural Language Processing, chatbots, image recognition</li> </ul> </li> <li>• Recognize the Machine Learning skills include:               <ul style="list-style-type: none"> <li>○ Technique used by AI</li> <li>○ Systems / Machines to learn from large data</li> <li>○ Supervised and Unsupervised learning</li> <li>○ Automation and scalability use in fraud detection.</li> </ul> </li> </ul>	U
		U
		K
		K
Training Machine Learning Models	<ul style="list-style-type: none"> <li>• Differentiate between supervised learning and unsupervised learning models including algorithms.</li> <li>• Apply the results from churn prediction and behavioral segmentation models</li> <li>• Discuss the Key Point Indicator of (KPI) of Churn Prediction Business Model</li> <li>• Discuss Data collection and Training the Datasets using supervised/ unsupervised/ reinforcement learning. (Kaggle.com)</li> </ul>	U
		A
		U
		U
		A

	<ul style="list-style-type: none"> <li>Apply Visualize interpret the results from churn prediction(Excel/ Kaggle/ PowerBI/ Colab/ matplotlib/ Panadas/ numpy/ seaborn in python)</li> </ul>	
[SLO CS-10-D-02] Students will understand and explain the types, uses, and methods of data visualizations and understand the benefits of visualizing data		
Relational Database Management system	<p>Students will be able to...</p> <ul style="list-style-type: none"> <li>Define relational databases (entities, attributes, and keys)</li> <li>Develop relational schema representing simple Entity-Relationship diagrams (MS Excel, MS Access, MySQL etc.)</li> <li>Create tables, forms, reports, and queries using common Arithmetic, Logical operations.</li> </ul>	<p>K</p> <p>A</p> <p>A</p>
Data Visualization and Interpretation	<ul style="list-style-type: none"> <li>Discuss data and data products (charts, graphs, and statistics) can be analyzed and evaluated, similar to analyzing arguments.</li> <li>Identify visualization techniques such as measures of center and spread, boxplots, bar plots, histograms, scatterplots, graphical summaries of multivariate data, side-by-side bar plots and association, scatterplots using Excel/python/ colab).</li> </ul>	<p>U</p> <p>K</p>
[SLO CS-10-D-03] Students will be able to apply stages of the data science life cycle e.g. understanding a real-world business problem, data gathering, building model, interpreting results).		
Data Science Life Cycle	<p>Students will be able to:</p> <ul style="list-style-type: none"> <li>Define Data Science Life Cycle</li> <li>Explain different steps of data gathering including the source of data, query the data on a database tool (e.g. MS Access, SQL Developer etc.), collect &amp; store the data, format the data to make it ready for modeling.</li> </ul>	<p>K</p> <p>U</p>
Implications of Data Science	<ul style="list-style-type: none"> <li>Discuss different types of real world business problems and how to formulate them into a data science problem.</li> <li>Define a problem e.g. which can calculate sales for next year as becomes a sales predictive model.</li> </ul>	<p>U</p> <p>K</p>

	<ul style="list-style-type: none"> <li>Formulate a business problem into a data science problem and link it to types of problems (e.g. questions “my customers are leaving me” is a churn prediction model)</li> </ul>	A
Decision Tree and Linear Regression Algorithm	<ul style="list-style-type: none"> <li>Discuss the linear regression or decision tree.</li> </ul>	U

**Domain E: Applications of Computer Science**

[SLO CS-10-E-01] Students will be able to describe uses and applications that are enabled by technologies like IoT, and Blockchain		
Theme	Detailed SLOs	Cognitive Level
Fundamental Components of IoT	Students will be able to: <ul style="list-style-type: none"> <li>Describe IoT and its fundamental components</li> <li>List out the applications of IoT used at different places</li> <li>Identify the best solution for an IoT system</li> </ul>	U K K
Scope of Blockchain & Cloud Computing	<ul style="list-style-type: none"> <li>Define What is Blockchain</li> <li>Discuss Application facilitated by blockchain technology such as Cryptocurrencies, Digital Identity, Voting System, Supply chain, etc.</li> <li>Differentiate between of IOT and Blockchain</li> <li>Define Cloud Computing</li> <li>Evaluate how we can use cloud computing</li> <li>Discuss the benefits of cloud computing</li> </ul>	K U  U  K U U

[SLO CS-10-E-02] Students will be able to explain that AI can be applied to specific applications in areas like NLP, Robotics, Speech Recognition, etc.		
Theme	Detailed SLOs	Cognitive Level
Speech Recognition and its Applications	Students will be able to: <ul style="list-style-type: none"> <li>Define Speech Recognition</li> <li>Describe Specific applications of speech recognition like personal assistants, Quran Memorization applications, Speech-to-text typing applications, Speech recognition for authentication, Speech recognition for surveillance and national security, Siri or Alexa etc.</li> </ul>	K U

<p>NLP and its application</p>	<ul style="list-style-type: none"> <li>• Define What is NLP?</li> <li>• Discuss types of NLP applications like email filtering to protect against spam and scams, language translation, document analysis, predictive text, Sentiment analysis, etc. how to useful in real world</li> </ul>	<p>K U</p>
<p>Robotics and its Application</p>	<ul style="list-style-type: none"> <li>• Relate the applications of Robotics like rescue and search operations, industrial robotics for manufacturing, vacuum cleaners like Romba robotic operations, farming, etc.</li> </ul>	<p>U</p>

[SLO CS-10-E-03]. Students will be able to demonstrate the social implications of AI		
Theme	Detailed SLOs	Cognitive Level
Social & Ethical Impact Assessment Of AI	<p>Students will be able to:</p> <ul style="list-style-type: none"> <li>• Describe that improper use of AI tools can result in injustice to specific groups of people.</li> <li>• Explain that AI designers have a responsibility towards ensuring that their algorithms target human benefit</li> <li>• Identify the ethical norms/ principles for creating AI algorithms</li> <li>• Show that there are instances where use of AI causes social injustices.</li> </ul>	<p>U</p> <p>K</p> <p>K</p> <p>U</p>

**DOMAIN F: Impacts of Computing**

[SLO CS-10-F-01]: *Understand and apply safe & responsible use of the internet to prevent addiction, promote information and data security*  
 Student Learning Outcomes 2: *Evaluate the impact of and apply strategies to prevent cyberbullying/harassment*

Theme	Detailed SLOs	Cognitive Level
Cyber World	<p><b>Students will be able to:</b></p> <ul style="list-style-type: none"> <li>• Discuss concerns of technology addiction</li> <li>• Explain importance of cybersecurity to protect data</li> <li>• Describe how the internet can be used to share information for both positive and negative purposes.</li> <li>• Describe effects of threats to individual privacy and security of data from spam, spyware, cookies, etc.</li> </ul> <p>Define basics of security &amp; privacy of cloud computing</p>	<p>U</p> <p>U</p> <p>U</p> <p>U</p> <p>K</p>
Cyber Security & Cyber Crimes	<ul style="list-style-type: none"> <li>• Define basics of data, network and cyber security: backups, access, network monitoring, public and private clouds</li> <li>• Understand use of hardware and software methods to protect devices</li> <li>• Analyze the impact of new technology laws on digital privacy and information security</li> <li>• Explain safety and security concepts and strategies, including how peer pressure and cyberbullying on social media affect people's lives.</li> <li>• Discuss the need for cybersecurity in relation to privacy and data security of information</li> <li>• Understand ways to protect devices and information from unauthorized access</li> <li>• Discuss ways to deal with cyberbullying as a victim or someone you know</li> <li>• Discuss cybercrime laws, instances of cybercrimes, and common methods of reporting cybercrimes</li> </ul>	<p>K</p> <p>U</p> <p>A</p> <p>U</p> <p>U</p> <p>U</p> <p>U</p> <p>U</p>

[SLO CS-10-F-02]: *Analyze the impacts of the digital divide on access to critical information*

Theme	Detailed SLOs	Cognitive Level
Access to Information	<p>Students will be able to:</p> <ul style="list-style-type: none"> <li>• Understand distribution of computing resources influence the strategies adopted for designing solutions</li> <li>• Discuss Inequitable Access to information impacts human lives</li> <li>• Describe meaning of the digital divide</li> </ul>	<p>U</p> <p>U</p> <p>U</p>

	<ul style="list-style-type: none"> <li>• Strategize to alleviate the impacts of unequal access of information in creating computing solutions</li> <li>• Discuss what role students can play to minimize the digital divide</li> </ul>	U
		U

**Domain G: Digital Literacy**

[SLO CS-10-G-01]: Communicate and publish key ideas and details to a variety of audiences using appropriate digital tools and media-rich resources		
Theme	Detailed SLOs	Cognitive Level
Identifying and Communicating Key Ideas	Students will be able to: <ul style="list-style-type: none"> <li>• Identify the main points (key ideas) from a case or event that need to be shared after studying it thoroughly.</li> <li>• Understand how to collect information on the topic and present them in different formats</li> </ul>	K
Use of digital media	<ul style="list-style-type: none"> <li>• Creating Effective Copy and Graphics for Idea Presentation (e.g. communicating event information in a poster, or communicating product features in a billboard)</li> </ul>	U
Used of Social Media to Communicate Key Ideas to Diverse Audiences	<ul style="list-style-type: none"> <li>• Use social media when communicating key ideas to various audiences (e.g. using YouTube to communicate an opinion via a podcast or using Instagram to show images related to a place or a product, or Facebook to share information with a community, or using of LinkedIn to create networking with relevant audiences etc.)</li> <li>• Discover best strategies for engaging audiences on different digital platforms (e.g., creating social profiles with accurate information, maintaining privacy, and using platforms appropriately).</li> </ul>	A
		U

**Domain H: Entrepreneurship in the Digital Age**

[SLO EN-10-A1-01]: Students will use digital tools to conduct research to collect market insights for an entrepreneurial solution		
Theme	Detailed SLOs	Cognitive Level
Market Analysis for an Entrepreneurial Solution	Students will be able to: <ul style="list-style-type: none"> <li>• Define quantitative and qualitative research methods and when to apply them.</li> <li>• Discuss how to design questions and collect results for various methodologies</li> </ul>	K
		U
		U

Interpretation of research findings and focusing	<ul style="list-style-type: none"> <li>• Explain interpreting research findings, focusing on addressing biases in sample selection and distinguishing between correlation and causation.</li> <li>• Discuss how to use research to validate business idea</li> <li>• Describe how to use research to create customer profiles</li> <li>• Create and implement a research plan to collect market insights for their business idea</li> <li>• Apply digital tools for survey collection, such as online questionnaires (Google forms, survey monkey) or MS excel for recording survey results</li> <li>• Create and arrange your research findings using computer software like word processing applications, ensuring clarity and structure for effective presentation.</li> </ul>	U
Digital Tools for Survey Collection		U
Research Presentation		A
		A

[SLO EN-10-A1-02] Students will learn how to pitch a business idea		
Theme	Detailed SLOs	Cognitive Level
Crafting an Effective Business Pitch	Students will be able to: <ul style="list-style-type: none"> <li>• Define what is the meaning of Pitching a business</li> <li>• Define Components of a successful business pitch</li> <li>• Define Components of a successful elevator pitch</li> <li>• Define effective communication skills required to best articulate a business idea</li> <li>• Difference between a business plan and a pitch document</li> <li>• Apply/Create an investor business pitch in a presentation software like MS PowerPoint, Google slides, or free online tools like Canva or pitch.com</li> <li>• Utilize effective communication skills to deliver the pitch</li> </ul>	K K K K U A A

# Grade-XI

## DOMAIN A: Computer Systems

[SLO CS-11-A-01] Students will be able to understand and apply logic gates in digital systems, define and create truth tables using Boolean operators like AND, OR, NOT, NAND, XOR) and logic diagrams.

Theme	Detailed SLOs	Cognitive Level
Digital Logic Basics	<b>Students will be able to:</b> <ul style="list-style-type: none"> <li>Define Boolean Functions and Expressions</li> <li>Understand Boolean Identities and operators</li> <li>Define logic gates and Digital Logic</li> <li>Describe and Differentiate Analog and Digital signals</li> <li>Explain Truth tables</li> <li>Define switches/logic diagrams</li> <li>Describe Key terms: Karnaugh maps, AND, OR, NOT, NAND gates, XOR</li> </ul>	K U K U U K U
Creating Truth Tables and logic gates	<ul style="list-style-type: none"> <li>Construct Boolean functions, expressions and identities. Recognize duality</li> <li>Identify different logic gates and explain their usage</li> <li>Create truth tables for expressions up to 3 inputs</li> <li>Draw logic gates for a Boolean expression</li> <li>Draw a truth table for a logic gate to identify the outputs</li> </ul>	A K A K K

[SLO CS-11-A-02] Students will be able to understand and evaluate stages of the systems design, e.g. software development life cycle (analysis, design, coding, and testing etc.), and software development methodologies

Theme	Detailed SLOs	Cognitive Level
Software Development Lifecycle	<ul style="list-style-type: none"> <li>Describe Software Development Life Cycle (SDLC)</li> <li>Discuss What are the different activities involved in each phase of the SDLC</li> </ul>	U U
Software Processes and Models	<ul style="list-style-type: none"> <li>Define basic software processes and Agile, Waterfall software process models</li> <li>Describe Key terms: bug, debugging, design patterns, UML.</li> </ul>	K U
Software Development Project Lifecycle Implementation	<ul style="list-style-type: none"> <li>Discuss Key activities in software development and the role of software development processes</li> <li>Describe The engineering nature of software development</li> <li>Describe Key concepts in software development such as risk and quality</li> <li>Relate the different stages of SDLC (analysis, design, coding, testing etc.) to a case study</li> <li>Plan a software project from beginning (design) to end (test and launch)</li> <li>(Advanced) Explain common software development processes (agile etc.)</li> </ul>	U U U U A U

	<ul style="list-style-type: none"> <li>• Explain black box and white box testing</li> </ul>	U
<b>[SLO CS-11-A-03]</b> Students will be able to understand and explain the scalability and reliability of networking systems via network topology		
Theme	Detailed SLOs	Cognitive Level
Network topologies System	<ul style="list-style-type: none"> <li>• Define Network topology</li> <li>• State different types of network topologies (Bus, Ring, Tree, Star, Mesh)</li> <li>• Define Advantages and disadvantages of each network topology</li> <li>• Define design, common access, and use of topologies</li> </ul>	K K K K
Scalability and Reliability	<ul style="list-style-type: none"> <li>• Define Availability, Scalability and reliability of a system/networking</li> <li>• Measure availability of a system</li> <li>• Prepare systems so they run with high reliability and can scale well</li> <li>• Test the scalability and reliability of a system</li> </ul>	K A A A
Key Terms in Networking and Computing	<ul style="list-style-type: none"> <li>• Define key terms: Hybrid, Ethernet, CSMA, Token passing, client, Server.</li> </ul>	K

[SLO CS-11-A-04] Understand and explain the need for cybersecurity and contrast different methods of encryption to transmit data.		
Theme	Detailed SLOs	Cognitive Level
Cybersecurity Fundamentals	<ul style="list-style-type: none"> <li>Define:               <ul style="list-style-type: none"> <li>Cybersecurity</li> <li>Encryption</li> <li>Ways a system can be attacked</li> <li>Basic security frameworks</li> </ul> </li> <li>Describe data policies and privacy policies and how they can help keep your information safe</li> </ul>	K  U
Cybersecurity Concepts	<ul style="list-style-type: none"> <li>Define key terms: Cryptography, DDoS, Hacking, Authentication, Authorization, Hashing, Malware, Phishing, XSS, Plaintext, Ciphertext, Decryption</li> </ul>	K
Basic Security Measures	<ul style="list-style-type: none"> <li>Describe security analysis and proactive protection of systems against cyber attacks</li> <li>Define Firewalls, 2FA (Two-Factor Authentication), Data Policies, Privacy Policies</li> </ul>	U
Protecting Computers	<ul style="list-style-type: none"> <li>Explain Protect their computers and setup online access taking in to account the security risks they are prone to</li> </ul>	U
Cyberattacks Security Risks	<ul style="list-style-type: none"> <li>Understand how basic cyberattacks are constructed and applies to real systems</li> <li>Analyze cyber security risk and create a plan to prioritize risk decisions</li> </ul>	U  A
Authentication & Encryption	<ul style="list-style-type: none"> <li>Understand basic encryption techniques and algorithms used to protect sensitive data protect sensitive apps and data through strong passwords, 2 factor authentication and encryption techniques.</li> </ul>	U

**DOMAIN B: Computational Thinking & Algorithm**

[SLO CS-11-B-01] Plan, develop, systematically test, and refine computational artifacts for problem-solving such as pseudocode, etc.		
Theme	Detailed SLOs	Cognitive Level

Develop pseudocode and Systematically Testing and refinement	<ul style="list-style-type: none"> <li>• Explain Pseudocode and its principles (Font size, font style, Data types, Variables, Line numbers, Indentation, case, declaration, keywords, etc.)</li> <li>• Identifying and fixing the errors.</li> <li>• Differentiate between Pseudocode and algorithm</li> <li>• Examine algorithm in term of correctness, efficiency and clarity</li> <li>• Match the flowchart's correctness with according to derived algorithm of problem.</li> </ul>	U K U A K
[SLO CS-11-B-02] Apply common search and sort algorithms		
Theme	Detailed SLOs	Cognitive Level
Searching and Sorting Algorithms	<ul style="list-style-type: none"> <li>• Apply Problem Solving methods with simple examples like: <ul style="list-style-type: none"> <li>○ Abstraction technique (Making a Tea: Finding out essential and variables)</li> <li>○ Pattern Recognition technique (By using words, character or symbols, etc.)</li> <li>○ Decomposition technique (A person learns a new language and how to form a sentence using a new foreign language by breaking it down into subparts like subject, verb, and object, etc.)</li> </ul> </li> <li>• Use the searching and sorting algorithms to solve computational problem.</li> </ul>	A A

### DOMAIN C: Programming Fundamentals

[SLO CS-11-C-01] Students should understand the importance of computer programming and applications		
Theme	Detailed SLOs	Cognitive Level
Agile and Waterfall models of SDLC	<ul style="list-style-type: none"> <li>• Discuss software development (Agile and Waterfall models of SDLC)</li> <li>• Discuss different programming languages and platforms</li> <li>• Take a real-world problem, propose a software solution and implement it</li> </ul>	U U A
Inputs and Outputs using basic components	<ul style="list-style-type: none"> <li>• Discuss program components (Input, process, output)</li> </ul>	U
[SLO CS-11-C-02] Students should be able to write and execute simple programs in Python.		
Theme	Detailed SLOs	Cognitive Level



**[SLO CS-11-C-06]** Students should be able to decompose a problem into sub-problems and implement those sub-problems using functions in Python

Theme	Detailed SLOs	Cognitive Level
Functions in Python & their uses	<ul style="list-style-type: none"> <li>Discuss decomposing a problem into a subproblem</li> <li>Explain how to avoid duplicate codes through function</li> <li>How to create/ define /invoke a function</li> <li>Create a program by decomposing a problem using multiple functions</li> </ul>	U U K A
Function types	<ul style="list-style-type: none"> <li>Identify types of Functions</li> </ul>	K
Function Parameters/ arguments, passing and returning values from functions	<ul style="list-style-type: none"> <li>Discuss function parameters/ arguments and returning values from a function</li> <li>Develop a program for arithmetic calculator using functions as arithmetic operations. Send arguments and return value from function</li> </ul>	U A
Scope of a Variable	<ul style="list-style-type: none"> <li>Discuss the scope of variables and its effect on program</li> </ul>	U

**[SLO CS-11-C-07]** Students will determine ways of debugging their code in Python

Theme	Detailed SLOs	Cognitive Level
Functions in Python for debugging	<ul style="list-style-type: none"> <li>Code written outside of a function is hard to test</li> <li>Code written inside a function can be tested</li> <li>How to write code that calls functions to ensure the results are correct</li> <li>Read through code and dry-run by hand to find bugs</li> </ul>	A A K K
Debugging using function & using breakpoints	<ul style="list-style-type: none"> <li>Identify different types of errors</li> <li>Discuss debugging</li> <li>Define breakpoints and console logs</li> <li>Debug a program</li> <li>Discuss debugging and testing (unit tests, breakpoints, watches)</li> <li>Debug a program/ code</li> <li>Apply breakpoints to analyze values of variables in JavaScript</li> </ul>	K U K A U A A
Using functions, debugger and breakpoints for debugging	<ul style="list-style-type: none"> <li>Use a debugger to set a breakpoint to stop execution of their code to see the state of variables for the purpose of discovering errors.</li> <li>Use functions for debugging</li> </ul>	A A

**DOMAIN D: Data and Analysis**

[SLO CS-11-D-01] Students will be able to relate the role and importance of model building with their real-world applications		
Theme	Detailed SLOs	Cognitive Level
Statistical Modeling and Linear Relationships	<p><b>Student will be able to:</b></p> <ul style="list-style-type: none"> <li>Apply data from one set of information to make predictions about another set (creating a line to understand the relationship between the two sets and use the correlation value to comprehend the linear connection).</li> <li>Determine the slope and starting position for the straight-line connection and create their initial statistical model.</li> <li>Identify relationships between real-world events and suggest recommendations based on findings.</li> <li>Discuss the different ways to use models, how to use them, choose the right models for different situations, and learn basic statistics like lines and more than one line.</li> <li>Discuss how variables are related in a straight line (using correlation numbers and creating the equation <math>y = mx + c</math> using slope and intercept)</li> </ul>	A
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		K
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		U

[SLO CS-11-D-02] Students will understand and explain experimental design in data science		
Theme	Detailed SLOs	Cognitive Level
Experimental Design in Data Science	<ul style="list-style-type: none"> <li>Discuss the importance of experimentation in data science as a tool to differentiate between correlation and causation.</li> <li>Explain the Data collection methods, including traditional methods of designed experiments and observational studies and surveys.</li> <li>Discuss measures used in experimentation</li> <li>Identify real world experimentation design examples</li> <li>Compare and contrast population vs. sample</li> <li>Compare and contrast parameter vs. statistic.</li> </ul>	U
		U
		U
		K
		U
		U

Implication Of Experimental Data Design	<ul style="list-style-type: none"> <li>• Apply a real-world business problem where experimentation is used. (e.g. Facebook, YouTube, online retail (GOOGLE TRENDS))</li> <li>• Explain situations where one measure of central tendency or spread may be more appropriate than others.</li> </ul>	A  U
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**[SLO CS-11-D-03]** Students will analyze pre-existing datasets to create summary statistics and data visuals (such as bar charts, pie charts, line graphs, etc.)

Theme	Detailed SLOs	Cognitive Level
Analyze Pre-Existing datasets	<ul style="list-style-type: none"> <li>• Discuss the relationship between databases and machine learning</li> <li>• Describing what is data analysis and data products, such as charts, graphs, and statistics.</li> <li>• Explore how data can be analyzed using tools like Excel, Google Sheets, R, or Python.</li> <li>• Discuss Collect, clean and manipulate data using tools such as Excel, Google Sheets, R, or Python</li> <li>• Analyze data using statistical techniques and create visual representations to effectively communicate findings.</li> </ul>	U  U  A  U  A
Data Visualization techniques and tools	<ul style="list-style-type: none"> <li>• Discuss Different visualization techniques (such as measures of center and spread, boxplots, bar plots, histograms, scatterplots) to data</li> <li>• Recognize the plot's name, understand the axes, spot trends, and identify any confounding factors.</li> <li>• Use visualization to tell stories with data Interpretation.</li> <li>• Create basic plots in Python</li> <li>• Create frequency tables in Python</li> </ul>	U   K  A  A  A

**DOMAIN E: Applications of Computer Science**

[SLO CS-11-E-01] Students should be able to describe technologies that are the foundations of IoT systems, Cloud Computing, and Blockchain		
Theme	Detailed SLOs	Cognitive Level
Technological foundations of IoT systems	<p><b>Student will be able to:</b></p> <ul style="list-style-type: none"> <li>Discuss the advancement in technologies like smaller size, higher processing power, longer battery power, AI techniques, cloud computing, and connectivity have enabled IoT applications</li> <li>Explain Network connectivity, Processing power, and Cryptography are technologies that enable blockchains.</li> <li>Analyze technologies that have enabled IoT and blockchain applications</li> </ul>	U
		U
		A

[SLO CS-11-E-02] Students should be able to evaluate how different stakeholder’s culture, values, and (sometimes conflicting) interests affect AI System designs.		
Theme	Detailed SLOs	Cognitive Level
Factors affecting AI System Design	<ul style="list-style-type: none"> <li>Discuss that there are different stakeholders that have vested interest in the outcomes of an AI algorithm</li> <li>Describe different stakeholders might have conflicting requirements for these algorithms</li> <li>Explore some of the stakeholders and describe their interest in AI algorithms</li> <li>Assess policies that can help protect different stakeholders' interests</li> <li>Evaluate how different stakeholder’s culture, values, and (sometimes conflicting) interests affect AI System designs.</li> </ul>	U
		U
		A
		A
		U

**DOMAIN F: Impact of Computing**

[SLO CS – 11- F-01] Understand and apply safe & responsible use of information sources, identifying sources of reliable information compared to unreliable information and its sources		
Theme	Detailed SLOs	Cognitive Level
Human & Computing Bias	<ul style="list-style-type: none"> <li>Discuss Safe &amp; responsible use of information sources</li> <li>Explain Human bias including data collection and information sharing</li> <li>Differentiate between data source verification tasks completed by humans and by computing devices</li> <li>Identify sources of reliable and unreliable information</li> <li>Address issues of bias in the designs and their computing applications</li> </ul>	U
		U
		U
		K
		A

	<ul style="list-style-type: none"> <li>Conduct data searches to obtain reliable information</li> </ul>	A
[SLO CS-11-F-02] Define and discuss how computing has increased connectivity by enabling communication between people and the environmental, cultural, and human impact of increased connectivity		
Theme	Detailed SLOs	Cognitive Level
Impact of Technologies & Digital divide	<ul style="list-style-type: none"> <li>Discuss uses of assistive technologies for people with disabilities and the elderly</li> </ul>	U
	<ul style="list-style-type: none"> <li>Discuss what is the mean of digital divide.</li> </ul>	U
	<ul style="list-style-type: none"> <li>Explain impact of the digital divide on connectivity and how accessibility to information influences the lives of different people</li> </ul>	U
	<ul style="list-style-type: none"> <li>Describe different technological innovations to improve communication between people such as Wi-Fi networks, Bluetooth etc.</li> </ul>	U
	<ul style="list-style-type: none"> <li>Discuss the impact of computing technology on business and commerce</li> </ul>	U
	<ul style="list-style-type: none"> <li>Understand strategies in providing equity and equal access to information</li> </ul>	U
	<ul style="list-style-type: none"> <li>Distinguish between impact of tasks completed by humans and by computing devices</li> </ul>	U

**DOMAIN G: Digital Literacy**

[SLO CS-11-G-01] Perform advanced searches to locate information and/ or design a data-collection approach to gather original data (e.g., qualitative interviews, surveys, prototypes, simulations)		
Theme	Detailed SLOs	Cognitive Level
Exploring Inquiry Methods	<ul style="list-style-type: none"> <li>Describe types of data (e.g., qualitative and quantitative)</li> </ul>	U
	<ul style="list-style-type: none"> <li>Definitions of data collection strategies (e.g., qualitative interviews, surveys, prototypes, simulations, observation etc.)</li> </ul>	K
Presentation of data	<ul style="list-style-type: none"> <li>Differentiate primary and secondary data</li> </ul>	U
	<ul style="list-style-type: none"> <li>Demonstrate how to present primary &amp; secondary data for a research question</li> </ul>	A
	<ul style="list-style-type: none"> <li>Use a data-collection approach to gather original data (e.g., qualitative interviews, surveys, prototypes, simulations)</li> </ul>	A
	<ul style="list-style-type: none"> <li>Present data using appropriate digital tools (such as graphs or infographics in worksheets, presentations, reports etc.)</li> </ul>	A

**DOMAIN H: Entrepreneurship in the Digital Age**

[SLO EN-11-A1-01] Students will create, test, and iterate a prototype for a business idea
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Theme	Detailed SLOs	Cognitive Level
Prototype Development and Validation in Entrepreneurship	<b>Students will be able to:</b> <ul style="list-style-type: none"> <li>• Describe What is prototyping and why is it important</li> <li>• Discuss How to design and test a prototype</li> <li>• Design, build and test the prototype</li> <li>• Derive learnings from prototype testing</li> <li>• Iterate business solution based on prototype test results</li> </ul>	U U A A A

# Grade: XII

## DOMAIN A: Computer Systems

[SLO CS-12-A-01] Students will explain the usability, security and accessibility of devices, the systems they are integrated with.		
Theme	Detailed SLOs	Cognitive Level
Usability and Accessibility	<b>Students will be able to:</b> <ul style="list-style-type: none"> <li>Define usability and accessibility of software applications</li> <li>Describe the effects of not building accessible applications</li> <li>Understand the social, ethical, economic and environmental implications of bad software and system design</li> <li>Describe Human-computer interaction, its significance, effective and satisfying user interactions</li> <li>Describe how design can make interfaces effective and user friendly</li> <li>Describe how design can affect a wide range of accessibility issues</li> <li>Explain what usability testing is</li> <li>How to design accessible user interfaces</li> </ul>	K
Accessibility Impact		U
Human Computer Interaction		U
Designing User Interfaces		U
		U U A
[SLO CS-12-A-02] Explain human interaction with computer systems in terms of: Usability Common problems Methods for improvements Ethical, social, economic, and environmental implications		
Theme	Detailed SLOs	Cognitive Level
Human-Computer Interaction	<ul style="list-style-type: none"> <li>Explain human interaction with computer systems in terms of: Usability, Common problems methods for improvements based on ethical, social, economic, and environmental implications</li> <li>Understand that Human-computer interaction is a field of study to promote efficient, effective and satisfying user interactions.</li> </ul>	U
		U
[SLO CS-12-A-03] Identify and explain tradeoffs between the usability and security of computing systems, recommend cybersecurity measures by considering different factors such as efficiency, cost, privacy, and ethics		
Theme	Detailed SLOs	Cognitive Level

Tradeoffs in Security and Usability	<ul style="list-style-type: none"> <li>• Differentiate tradeoffs between making a system more secure vs. making it more usable.</li> </ul>	U
Importance of security	<ul style="list-style-type: none"> <li>• Describe the factors, around efficiency, cost, privacy and ethics when it comes to cybersecurity</li> <li>• Explain that both security and user experience are essential features for any software system</li> <li>• Describe how to implement basic cybersecurity measures that take usability into account</li> </ul>	U U U
Zero Trust Approach	<ul style="list-style-type: none"> <li>• Explain zero-trust approach and how to design for it</li> <li>• Differentiate data privacy and security when designing an application</li> <li>• Design ways to simplify app security (e.g. simplified 1-click authentication, design for transparency etc.) so the experience is more seamless</li> </ul>	U U A
Balance Security Design	<ul style="list-style-type: none"> <li>• Describe Balance security design of application such that efficiency, cost, privacy and ethics are not compromised</li> </ul>	U

**DOMAIN B: Computational Thinking & Algorithm**

[SLO CS-12-B-01] Understand and evaluate the computational solution in term of efficiency, clarity and correctness		
<b>Theme</b>	<b>Detailed SLOs</b>	<b>Cognitive Level</b>
Computational Solution	<b>Student will be able to:</b> <ul style="list-style-type: none"> <li>• Explain time and space trade off of algorithms (Simple &amp; Complex)</li> <li>• Evaluate data Structure such as array and trees)</li> <li>• Write the impact of data structure over on efficiency of algorithm.</li> </ul>	U A K
[SLO CS-12-B-02] Understand and apply complex algorithms on data structures such as tree and binary search		
<b>Theme</b>	<b>Detailed SLOs</b>	<b>Cognitive Level</b>
Complex Algorithm on data structure	<ul style="list-style-type: none"> <li>• Define data structure such as: Array, List, trees, Stack &amp; Queue</li> <li>• Explain binary Search</li> <li>• Apply tree data structure</li> <li>• Apply the binary search algorithm in complex problem</li> <li>• Define term traversing in data structure.</li> <li>• Explain the Methods of traversing in trees: In-Order</li> </ul>	K U A A K

	Pre-Order, Post-Order <ul style="list-style-type: none"> <li>Apply traversing over a tree using all three techniques (e.g., Office Employees, Family tree, etc.)</li> </ul>	U  A
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### DOMAIN C: Programming Fundamentals

[SLO CS-12-C-01] Students should be able to understand and evaluate applications of various programming paradigms.

Theme	Detailed SLOs	Cognitive Level
Using Classes & Objects in Python	<b>Student will be able to:</b> <ul style="list-style-type: none"> <li>Propose of programming language paradigms to reduce complexity and make code easy</li> <li>Compare pros/cons of Object-Oriented Programming and functional programming</li> <li>Write a Python program using Object Oriented Programming to define a class with instance attributes to manage states</li> </ul>	K  U  A

[SLO CS-12-C-02] Students should be able to use more advanced programming constructs such as data structures (lists etc.), file handling (disk IO to write to storage), and databases in Python.

Theme	Detailed SLOs	Cognitive Level
Lists	<b>Student will be able to:</b> <ul style="list-style-type: none"> <li>Describe purpose of a list to store an ordered list of elements.</li> </ul>	U
Dictionary and Key	<ul style="list-style-type: none"> <li>Describe the purpose of a dictionary to store key-value pairs</li> <li>Explain that if a key is given, finding a value in a dictionary is faster than in a list (Compare list &amp; Dictionary).</li> </ul>	U  U
File handling (disk I/O) write to storage	<ul style="list-style-type: none"> <li>Explain the importance of disk I/O?</li> <li>Define file handling methods and file operations (Create, Read and Write, etc.)</li> </ul>	U  K
Databases in Python	<ul style="list-style-type: none"> <li>Explain the use of database</li> <li>Operate a database tool (e.g. MS Access, MySQL, etc.)</li> <li>Describe Data normalization up to third form Primary key, secondary key, etc.</li> <li>Know, how to connect databases with python programming.</li> </ul>	U A U  K

[SLO CS-12-C-03] Students should be able to implement complex algorithms that use lists etc. in Python

Theme	Detailed SLOs	Cognitive Level
Nested Lists & its use with dictionary	<ul style="list-style-type: none"> <li>Explain the concept of a nested list (list within a list)</li> <li>Use a list as a value within a dictionary</li> </ul>	U  A

	<ul style="list-style-type: none"> <li>• Make a program using both lists and dictionary</li> </ul>	A
[SLO CS-12-C-04] Students will determine more advanced techniques (unit tests, breakpoints, watches) for testing and debugging their code in Python		
Theme	Detailed SLOs	Cognitive Level
Unit test, break points, watches for Debugging	<ul style="list-style-type: none"> <li>• Define the purpose of a unit test.</li> <li>• Write a unit test for the functions in their code</li> <li>• Use break point, Watches, print statement for debugging</li> <li>• Explain debugging allows programmers to analyze code as it runs</li> <li>• Use a print statement to help debug bugs in their code</li> </ul>	K A A U A

**DOMAIN D: Data and Analysis**

[SLO CS-12-D-01] Students will be able to analyses data and identify key model performance metrics of real-world machine learning models.		
Theme	Detailed SLOs	Cognitive Level
Key Performance Metrics of real-world Machine learning Models	<ul style="list-style-type: none"> <li>• Differentiate between machine learning and rule-based algorithms.</li> <li>• Discuss basics of machine learning model building, i.e., feature engineering, train-test split and model assessment</li> <li>• Discuss how to “learning from the data” works and which algorithms fit which data structures best.</li> <li>• Differentiate between predictive outcomes vs. causality</li> </ul>	U U U U
Model Evaluation and Validation	<ul style="list-style-type: none"> <li>• Build a simple machine learning model from data collection and cleaning to model assessment with features as inputs and predictive values as the outcome and they will be able to explain the meaning of these results in a real-world scenario.</li> <li>• Assess model with metrics appropriate for the algorithm type and improve on the model using hyperparameter tuning</li> <li>• Discuss the use of machine learning to a real-world problem (using Excel, Python, or R, Jupyter notebooks etc.)</li> <li>• Interpret the results of the model output including features with most impact</li> </ul>	A A U U

	<ul style="list-style-type: none"><li>• Evaluate the model using various metrics and assess the model with a validation dataset.</li></ul>	A
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[SLO CS-12-D-02] Students will explain and create a data visualization using data visualization software (for example, Structured Query Language (SQL), Python, or R)		
Theme	Detailed SLOs	Cognitive Level
Data Collection techniques and tools	<ul style="list-style-type: none"> <li>• Discuss Data storytelling</li> <li>• Read and critique/Assess published data stories and visualizations</li> <li>• Discuss How to formulate questions from existing data sets.</li> <li>• Evaluate how the new data stories compare against the old.</li> <li>• Discuss a sample data set from the internet or known surveys</li> </ul>	U K U A U
Feature Engineering and Feature Learning Using SQL, Python and R coding	<ul style="list-style-type: none"> <li>• Use R or Python to create visualization Download open source data from Kaggle, NASA, government websites, (<u>IRIS</u> or <u>TITANIC</u> from sites such as <a href="https://www.kaggle.com/">https://www.kaggle.com/</a>).</li> <li>• Set up python environment and apply Python functions</li> <li>• Know techniques of descriptive statistics, to construct multiple views of data in an attempt to uncover new insights</li> </ul>	A A A
[SLO CS-12-D-03] Students will learn how to form hypotheses and perform hypothesis testing. Students will learn to communicate findings using advanced data visuals and tie them back to hypotheses.		
Theme	Detailed SLOs	Cognitive Level
Bias-Variance Tradeoff and hypothesis testing using statistics	<ul style="list-style-type: none"> <li>• Define the concept of hypothesis testing</li> <li>• Define the Concept of simple hypothesis testing</li> <li>• Apply P-values and significance tests and making conclusions using statistics</li> <li>• Apply visuals to support hypothesis</li> <li>• Discuss how to Write null and alternative hypothesis</li> </ul>	K K A A U
Estimating a P-value, Null and Alternative Hypotheses	<ul style="list-style-type: none"> <li>• Estimate a P-value from a simulation</li> <li>• Draw a visual graph/bar chart or histogram to tie it back to the conclusion</li> </ul>	U A A

	<ul style="list-style-type: none"> <li>Perform F-tests, Chi-Square Tests and complete the remaining modules on <a href="#">Hypothesis Testing &amp; Statistics- Videos &amp; Lessons   Study.com</a></li> </ul>	
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**DOMAIN E: Applications of Computer Science**

**[SLO CS-12-E-01]** Students should be able to design ideas of applications relevant to Pakistan using IoT, Cloud computing, and Blockchain

Theme	Detailed SLOs	Cognitive Level
Specific IoT applications that are viable in the context of Pakistan	<ul style="list-style-type: none"> <li>Explain that IoT applications are applicable to Pakistan be able to come up with ideas on what applications are needed in the community Brainstorm and determine if a particular idea of an application is useful in the Pakistani context</li> </ul>	U

**[SLO CS-12-E-02]** Students should be able to describe deep learning and its applications

Theme	Detailed SLOs	Cognitive Level
Neural Network and Deep Learning	<ul style="list-style-type: none"> <li>Describe the relationship between neural networks and deep learning networks</li> <li>Identify applications of neural and deep learning networks</li> </ul>	U K
Dataset Extraction by Deep learning	<ul style="list-style-type: none"> <li>Understand the deep learning networks help us extract features from a given dataset</li> <li>Identify applications of neural and deep learning networks.</li> </ul>	U K

[SLO CS-12-E-03] Students should be able to assess policies that can help protect different stakeholders' interests

[SLO CS-12-E-04] Students should be able to evaluate scenarios with data sharing and privacy conflicts and suggest policy decisions that can help achieve acceptable compromises.

Theme	Detailed SLOs	Cognitive Level
Challenges and trade-offs involved in balancing data sharing and privacy	<ul style="list-style-type: none"> <li>Understand that Data sharing and privacy have conflicting requirements.</li> <li>Discuss each policy decision with conflicting interests requires compromises.</li> <li>Think critically about data sharing and privacy conflicts and develop the ability to evaluate different perspectives and arguments.</li> </ul>	U
		U
Mitigating Collaboration, communication, and negotiation skills in the context of data sharing and privacy conflicts	<ul style="list-style-type: none"> <li>Articulate their viewpoints and respond to opposing views. They will also develop their ability to express complex ideas and information in a clear and concise manner.</li> <li>Collaborate, communicate, and negotiate with one another</li> <li>Suggest policy decisions to mitigate data sharing and privacy conflicts</li> </ul>	A
		A
		U

**DOMAIN F: Impacts of Computing**

[SLO CS-12-F-01] Identify and apply safe practices when collaborating on digital or online platforms.

Theme	Detailed SLOs	Cognitive Level
Best practices over Digital platforms	<ul style="list-style-type: none"> <li>Define the necessity of security protocols for the secure storage and transmission of data</li> <li>Understand when and how their information is collected and used</li> <li>Understand user's private information can be used as fake/stolen identity</li> <li>Define different types of cyber attacks:DDoS attack, ransomware, spyware, viruses, phishing,</li> <li>Describe security basics of cryptography and ciphers used for safe transmission of data e.g., 2FA, biometric verification</li> <li>Identify security threats in the use of different computing applications and devices</li> <li>Identify Troubleshoot issues to support security of systems and applications</li> <li>Find a cybersecurity threat and be able to apply strategies to correct it</li> </ul>	K
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**[SLO CS-12-F-02]** Discuss security threats and mitigation such as 2FA, biometric verification, and secure techniques for transmitting data etc.

Theme	Detailed SLOs	Cognitive Level
Cyber Security	<ul style="list-style-type: none"> <li>Explain significance of security methods for the storage and transmission of data</li> </ul>	U
	<ul style="list-style-type: none"> <li>Different security methods used: 2FA, biometric verification</li> </ul>	U
	<ul style="list-style-type: none"> <li>Define the Basics of cryptography and ciphers used for safe transmission of data</li> </ul>	K
	<ul style="list-style-type: none"> <li>Understand when and how their information is collected and used</li> </ul>	U
	<ul style="list-style-type: none"> <li>Define that giving away private information can make it easier for your identity to be stolen</li> </ul>	K
	<ul style="list-style-type: none"> <li>Define different types of cyber-attacks: DDoS attack, ransomware, spyware, viruses, phishing</li> </ul>	K
	<ul style="list-style-type: none"> <li>Apply basic security methods for developing computing applications</li> </ul>	A
	<ul style="list-style-type: none"> <li>Evaluate security protocols used in different computing systems and devices</li> </ul>	A
	<ul style="list-style-type: none"> <li>Identify security threats in the use of different computing applications and devices</li> </ul>	K

**[SLO CS-12-F-03]** Collaborate on strategies to provide equity and equal access to information

Theme	Detailed SLOs	Cognitive Level
Access to Information	<ul style="list-style-type: none"> <li>Understand need to develop computational perspectives for valuable future career</li> </ul>	U
	<ul style="list-style-type: none"> <li>Understand importance for collaborations to improve designs of computing applications</li> </ul>	U
	<ul style="list-style-type: none"> <li>Communicate with others on the design of computing technologies</li> </ul>	A
	<ul style="list-style-type: none"> <li>Strategize to improve collaborations between different teammates using technology resources</li> </ul>	A
	<ul style="list-style-type: none"> <li>Create artifacts that address issues of equity in terms of access to information</li> </ul>	A
	<ul style="list-style-type: none"> <li>Explore collaborative tools for use online for example Google Drive, Slack, Trello etc.</li> </ul>	A

**DOMAIN G: Digital Literacy**

**[SLO CS-12-G-01]** Students will create an artifact that answers a research question, communicates results and conclusions through digital resources or tools

Theme	Detailed SLOs	Cognitive Level
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Digital Inquiry	<ul style="list-style-type: none"> <li>• Perform advanced searches to locate information of research topic (e.g. advanced search in Google, AI to find and summarize information)</li> <li>• Use digital tools to effectively communicate results and conclusions (e.g. Canva, Adobe Illustrator, Figma, etc.)</li> <li>• Create an artifact that answers a research question, communicates results and conclusions through digital resources or tools</li> <li>• Present the findings and conclusions drawn from the digital artifact (e.g., reports, presentations, prototypes, etc.)</li> </ul>	<p>A</p> <p>A</p> <p>A</p> <p>A</p>
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**DOMAIN H: Entrepreneurship in Digital Age**

[SLO EN-12-A1-01] Students will create and test a minimum viable product for their business		
Theme	Detailed SLOs	Cognitive Level
Blueprint for Launching a Minimum Viable Product (MVP)	<ul style="list-style-type: none"> <li>• Discuss What is minimum viable product (MVP)</li> <li>• Differentiate between MVP and prototype</li> <li>• Discuss What is the Riskiest (Business Model) assumption and how to identify it</li> <li>• Discuss How to design a test using an MVP</li> <li>• Discuss How to identify “beachhead market” for MVP testing</li> <li>• Design, create, and test an MVP for a business idea for their beachhead market</li> </ul>	<p>U</p> <p>U</p> <p>U</p> <p>U</p> <p>U</p> <p>A</p>

## PERIODS ALLOCATIONS

	IX				X			
	No. of SLOs	Total Period	TH	PR	No. of SLOs	Total Period	TH	PR
<b>Domain A: Computer Systems</b>	3	21	15	6	3	19	13	6
<b>Domain B: Computational Thinking &amp; Algorithms</b>	2	14	10	4	2	12	8	4
<b>Domain C: Programming Fundamentals</b>	5	35	11	24	5	37	11	26
<b>Domain D: Data Analysis</b>	3	21	15	6	3	18	12	6
<b>Domain E: Applications of Computer Science</b>	2	14	10	4	3	18	12	6
<b>Domain F: Impacts of Computing</b>	3	21	15	6	3	18	12	6
<b>Domain G: Digital Literacy</b>	0		0		1	6	4	2
<b>Domain H: Entrepreneurship in the Digital Age</b>	2	14	10	4	2	12	8	4

	XI		THEORY	PRACTICAL	XII		THEORY	PRACTICAL
	No. of SLOs	Total Period			No. of SLOs	Total Period		
<b>Domain A: Computer Systems</b>	4	33	23	10	3	25	17	8
<b>Domain B: Computational Thinking &amp; Algorithms</b>	2	18	12	6	2	18	12	6
<b>Domain C: Programming Fundamentals</b>	7	58	18	40	5	42	14	28
<b>Domain D: Data Analysis</b>	3	25	17	8	3	25	17	8
<b>Domain E: Applications of Computer Science</b>	2	17	11	6	4	33	23	10
<b>Domain F: Impacts of Computing</b>	2	17	11	6	3	25	17	8
<b>Domain G: Digital Literacy</b>	1	9	7	2	1	9	7	2
<b>Domain H: Entrepreneurship in the Digital Age</b>	1	9	7	2	1	9	7	2

## Guideline for Authors

In textbook writing generally the following aspects may be taken into consideration:

- The textbook should fulfill the objectives of teaching Computer Science (Grade IX to Grade XII)
- The author should continuously focus on standard, benchmarks and SLOs and skill sets defined in the curriculum outlines/skills.
- The textbook should be designed specifically to achieve the Competencies for grade IX to grade XII.
- Textbook developers and designers should be aware of the Competencies of Computer Science and different domains (as reported in curriculum).
- Textbook developers should have sound knowledge of the discipline – Computer Science
- The content and sequence included in the textbook should be carefully authored not to contradict some of the core principles of these disciplines.
- Textbook developers need to have a clear understanding of the pedagogy that is appropriate for the competency and content (e.g., in language the balanced approach of including oral language, phonics and word solving instruction and meaning making needs to be incorporated)
- Textbook developers should be aware of the current technology and audio-visual materials available for enhancing learning experiences of students. Activities that involve digital technology and references to external material should be embedded appropriately in the textbook.
- The local context and environment are important in Grade IX to Grade XII. Authors shall take care for the choice of content in the textbook. Moving from the familiar to unfamiliar is an important aspect of learning and the textbook should contain a balance of both familiar contexts that is a comfort for the children and unfamiliar contexts that should generate curiosity and challenge to students' thoughts and preferences.
- The textbooks should grab the attention of students. For Grade IX to Grade XII, the balance between visual material and text should be tilted towards visual materials. The colour schemes and design themes should be attractive and consistent. The fonts and size of text material should be both visible and least confusing for students. The flow of concepts, clarity in articulation and well-designed illustration to show the concepts/terminologies would be important.

- it is important to maintain diversity and inclusion as an important principle in the choice of content for textbooks. There are regional variations and these need to find adequate representation in textbooks. Balanced gender and community representation must be ensured.
- The topics/themes chosen would need to include the context of the student (including previous experiences, language) and scope for further exploration. The content at each Grade should be a precursor to the next. It is essential to ensure an alignment of the pedagogy and assessment with the content and the Learning Outcomes.
- Content in textbooks is largely directed towards students. It has been a practice to include notes for teachers in the textbook (It is recommended that for each textbook released for students, there should be a relevant textbook for the teacher for that student's textbook).
- The presentation of a textbook relies on the font size, images, sketches, the colors used, and on the amalgamation of the three e.g., textual content in the early Grades may be limited with a large number of images, font size should be large, and the illustrations used should be sensitive and inclusive. The language used would need to be Grade-appropriate and relevant to the subject.
- The textbook shall emphasize on critical thinking and more holistic, inquiry-based, discovery-based, discussion-based, and analysis-based learning. The content shall focus on key concepts, ideas, applications, and problem solving abilities.
- The chapters and its objectives/outcomes shall give clear direction as to what content is to be used for creating learning experiences for students [For example, concepts formed are perceptive in lower grades (e.g., color as visually discriminated) and practical (e.g., spoon used as a lever to open a tin cover, money to buy things in a shop) but not theoretical (e.g., color as a spectrum of light, lever as a simple machine, or money as a medium of exchange). Theoretical concepts be explored in the higher grades.]
- The content should be tied/bonded to building capacities and values that students need to develop through schooling at different grades. Special care should be taken to avoid promotion of stereotypes (i.e., fixed and distorted impression).
- The title page should be attractive and representative of the content of the textbook
- The textbook should include detailed table of contents
- Each chapter should report the outcomes of the chapter.
- The text should be clear and concise; unnecessary details must be excluded.

- The material should not be cramped. To make it more digestible, it may be chunked into smaller parts with headings.
- The textbook should be visually appealing and should maintain the interest of the students (i.e., use of pictorial views, images, use of innovative and attractive ways)
- The color scheme of pictures should be close to real life (i.e., 3D images)
- Activities/ Exercises must be designed related to 21st Century learning skills like critical thinking and problem solving as mentioned in the curriculum (e.g., see details at childnet.com or code.org or National Book Foundation or Oxford Series Level-1 to Level-9)

[References:

[https://www.mediafire.com/file/yovzo9oqdm6kmdm/Oxford\\_Computing\\_Book\\_6.pdf/file](https://www.mediafire.com/file/yovzo9oqdm6kmdm/Oxford_Computing_Book_6.pdf/file) (page#05 & 07) and

[https://www.mediafire.com/file/n8f03plaozpv2i/Oxford\\_Computing\\_Book\\_8.pdf/file](https://www.mediafire.com/file/n8f03plaozpv2i/Oxford_Computing_Book_8.pdf/file) (page#03)]

- The author should bring himself/herself to the mental level of students, while he/she writes the chapters of the textbook.

### **Guideline for Teacher Educators (Trainers)**

The trainers (teacher educators) generally follow the following guidelines while training teachers of Computer Science (Grade IX to Grade XII):

#### **General guidelines**

- Trainer ensures that teachers know themselves about the bloom's taxonomy levels (Cognitive, Affective and Psychomotor domains and their levels)
- Trainer ensures that teacher fully understands that students are of different wisdom/knowledge and background, thus, apply average level while explaining concepts.
- Trainer ensures that teacher knows that students make teachers their role model, thus, teacher should take care of his/her actions and selection of appropriate words while speaking to them.
- Trainer focuses that teachers make use of more class activities and discussion sections (Repeat the discussions to improve students' thinking ability)

- Trainer emphasizes that teacher provide accurate, concise and in simple words definitions of the concepts with real world examples.
- Trainer trains teachers to emphasize on discussion of students by forming groups of the students in the class.
- Trainer informs teachers to focus on the skills of the students in using technology and solving problems
- Trainer ensures that teacher should improve students' self-learning, collaborative learning approaches
- Trainer emphasizes that teacher monitors students' behavior towards classmates and safe use of ICT devices
- Trainer trains teachers to use less homework activities and increase class/lab activities, discussions, brainstorming sessions to build students' critical thinking mindset and expressing their ideas
- Trainer ensures that teacher teach students sportsmanship, gracefully accepting others' ideas and success/winning of competitions/games
- Trainer ensures that teacher focus on development of effective problem-solving and logical reasoning abilities in students.

Some effective guidelines for teacher educators based on best practices (Reference: Oxford) are reported in the following.

### **1. Model Exemplary Teaching:**

- i. Demonstrate effective teaching strategies: During workshops and training sessions, actively model diverse and engaging teaching methods aligned with current best practices. This sets a strong foundation for participants to learn and apply.
- ii. Embrace different learning styles: Showcase activities and techniques catering to varied learner preferences, demonstrating how to differentiate instruction in real-world scenarios.
- iii. Utilize technology for effective learning: Integrate technology seamlessly into your training sessions, demonstrating its potential to enhance engagement, interaction, and feedback.

### **2. Foster Collaborative Learning:**

- i. Create opportunities for peer interaction: Design activities and discussions that encourage participants to share experiences, ideas, and challenges with each other. This fosters collaboration, learning from diverse perspectives, and problem-solving skills.
- ii. Promote reflective practice: Encourage participants to critically analyze their own teaching practices, using peer feedback and collaborative discussions as learning tools. This fosters a culture of continuous improvement and reflection.
- iii. Build professional learning communities: Facilitate the creation of networks or online communities where teacher educators can continue to collaborate, support each other, and share best practices beyond the training program.

### **3. Bridge Theory and Practice:**

- i. Ground training in educational theory: Provide foundational knowledge in key educational theories, such as pedagogy, assessment, and curriculum development. This equips teacher educators with a strong theoretical framework to inform their own practices and guide their trainees.
- ii. Offer practical application scenarios: Ensure theoretical concepts are connected to real-world teaching challenges through case studies, simulations, and role-playing activities. This allows participants to apply knowledge in practical settings and develop effective solutions.
- iii. Focus on critical thinking and problem-solving: Encourage participants to analyze educational problems, research best practices, and design individualized solutions for diverse teaching contexts.

### **4. Provide Ongoing Support:**

- i. Offer mentoring and coaching: Extend support beyond the training program by providing mentoring or coaching opportunities for aspiring or new teacher educators. This allows for personalized guidance, feedback, and problem-solving assistance.
- ii. Develop online resources and communities: Create online resources, such as webinars, discussion forums, and knowledge repositories, for ongoing access to information, support, and professional development opportunities.

- iii. Foster a culture of self-directed learning: Equip teacher educators with the skills and resources to actively seek out new knowledge, stay updated on current trends, and continuously improve their own teaching practices.

## **5. Cultivate a Reflective Culture:**

- i. Model reflective practice: As a teacher educator, actively demonstrate and discuss your own reflective practices, encouraging participants to do the same. This normalizes reflection as a critical tool for professional growth.
- ii. Promote data-driven decision making: Encourage participants to collect and analyze data from their own teaching practices, utilizing it to inform decisions, set goals, and track progress.
- iii. Facilitate continuous feedback loops: Establish systems for regular feedback, both within training sessions and beyond, allowing participants to receive constructive criticism and guidance for improvement.

## **Guideline for Teachers**

The concerned teachers generally follow the following guidelines while teaching Computer Science (Grade IX to Grade XII):

### **General Guidelines**

- The teacher selects and uses planning, preparation and assessment practices that progress students' learning
- Teacher uses appropriate digital technologies to support differentiated learning, enabling learners to take ownership of their individual learning needs.
- Teacher uses appropriate digital technologies to help students design projects and activities that engage them in collaborative problem solving, research, and/or artistic creation.
- Teacher ensures that students are able to work collaboratively in groups and complete and submit work at school and at home.
- Discuss other activities or tasks and accomplish them by carefully executing a set of steps. The focus should be on essence of steps involved in solving the problem.
- Teacher ensures that students use logical reasoning to explain how some simple algorithms work and to detect and correct errors in algorithms and programs/problems.

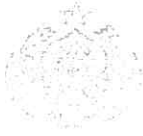
- Teacher focus on how to use technology safely, respectfully and responsibly; recognise unacceptable behaviour; identify a range of ways to report concerns about content and contact.
- Teacher revises the importance of passwords, exploring cyberbullying and computer security and using an online space to safely share ideas. (class blog/shared google doc etc)
- Teacher ensures that students perform plugged and unplugged activities of computer accessories (i.e., keyboard, mouse, power cable) and discuss.
- Teacher ensures that students can represent data in different ways, collect, sort and present it in digital forms (Data Visualization using MS Word, MS Excel, MS PowerPoint etc).
- Teacher ensures that students can decompose simple problems and create simple sequences of instructions (e.g., how to make a sandwich, brush your teeth, bake a cake etc)
- Teacher ensures that students understand what algorithms are, how they are implemented as programs on digital devices, and that programs execute by following precise and unambiguous instructions.
- Teacher ensures that students follow the problem-solving process to design and create a digital solution.
- Teacher ensures that students are familiar with and able to submit and complete work both at school and at home and are able to submit via online means (i.e., emails, Google Meet, MS Teams, Google Docs etc)
- Teacher ensures that students make choices based on rational analysis & on a ground understanding of the world and acting on those choices; this indicates that the student should have the capacity for rational reasoning and sufficient knowledge to understand the world around him/her.
- Teacher ensures that students realizes that a healthy mind and a healthy body are the foundations for an them to pursue a good life and contribute meaningfully to society.
- Teacher ensures that students adopt healthy discussions for the creative and innovative ideas about problems surrounding them.
- Teacher ensures that students understand the discipline, hormone and cultural differences.
- Teacher ensures that students develop their ability to speak, listen, question, discuss, and write with clarity and conciseness – and with confidence and friendliness
- Teacher ensures that students engage in conversations/discussions based on events, stories, or their needs and asks questions. Besides, students demonstrate civilized behavior (waits for their turn to speak, and allows others to speak)

- While teaching-learning process is going on, Teacher observes and assesses-
  - Which student is actively participating in the discussion and contributing to it and which student is not able to do so.
  - Whether students are trying to explore for the possible solutions of a problem and are looking for the best one.
  - The extent of the participation of the students in group discussions, problem solving and their communication skills during these exercises.
  - How students are trying to solve the problem through various ways and are using appropriate methods for doing this.
  - Assessment in groups, peer assessment and opportunities for self-assessment also help in self-correction. Teacher should collect information and evidence through different sources, methods and techniques, record of information or evidence and make sense of collected information or evidence and share and communicate feedback.
- Teachers can use digital content available on the internet for supplementing the textbook material. Such content can enable different pedagogical approaches as well as provide different forms of engagement through audio-visual material.

**A Teacher shall:**

- Focus on learner-centered instruction: Create a classroom environment where students are actively engaged and responsible for their learning. This can involve project-based learning, group work, and differentiated instruction.
- Utilize evidence-based strategies: Base your teaching practices on research and best practices in education. This includes incorporating effective instructional methods, assessment techniques, and classroom management strategies.
- Promote effective communication: Develop clear and concise communication skills, both oral and written, to ensure accurate delivery of information and understanding among students.
- Create a positive and supportive learning environment: Foster a classroom atmosphere where students feel safe, respected, and valued. This encourages active participation, risk-taking, and collaboration.
- Provide regular feedback and assessment: Offer constructive feedback and utilize various assessment methods to monitor student progress, identify areas for improvement, and personalize learning.

- Provide regular and constructive feedback: Offer actionable feedback to students that motivates them to improve. Utilize formative and summative assessment to gauge progress, identify areas for growth, and personalize learning.
- Integrate technology thoughtfully: Leverage technology tools to enhance learning, connect with students, and facilitate engagement. However, prioritize meaningful interaction and critical thinking over technology dependence.
- Embrace continuous learning and reflection: Actively seek out opportunities to learn and grow as an educator. Reflect on your own teaching practices, analyze student data, and seek feedback from colleagues to continuously improve.
- Differentiate instruction to meet diverse needs: Recognize and cater to individual learning styles, strengths, and weaknesses. Modify materials, activities, and assessments to ensure all students have the opportunity to reach their full potential.
- Foster a growth mindset: Encourage students and yourself to embrace challenges and see mistakes as opportunities for learning. Cultivate a culture of resilience, perseverance, and lifelong learning.



GOVERNMENT OF SINDH  
SCHOOL EDUCATION & LITERACY DEPARTMENT

Karachi, dated the 31<sup>st</sup>, July 2024.

**NOTIFICATION**

NO. SELD/HCW/18/2018: In compliance with the Section 3, sub-section (4), (c) of Sindh School Education Standards & Curriculum Act 2014, Sindh Act No. IX of 2015. School Education & Literacy Department, Government of Sindh is pleased to accord **No Objection Certificate** for approval of **Sindh Curriculum for Computer Science & Entrepreneurship 20 24 for Grade IX-XII**, aligned with the adopted Standards of National Curriculum of Pakistan (NCP) 2022-23, after review by the Provincial Review Committee constituted for Computer Science & Entrepreneurship Curriculum 2023-24.

**ZAHID ALI ABBASI**  
SECRETARY TO GOVERNMENT OF SINDH

NO. SELD/HCW/18/2018:

Karachi, dated the 31<sup>st</sup>, July 2024.

A copy for information and necessary action to:

1. The Chairman, Sindh Textbook Board, Jamshoro.
2. The Chief Advisor Curriculum Wing, School Education & Literacy Department, Government: of Sindh, Karachi.
3. The Director, Directorate of Curriculum, Assessment & Research, Jamshoro.
4. The P.S to Secretary School Education & Literacy Department, Government: of Sindh, Karachi.
5. The official website.
6. The office file.



SCHOOL EDUCATION &  
LITERACY DEPARTMENT  
GOVERNMENT OF SINDH



*Zahid Ali Abbasi*  
31/7/2024  
✓ SECTION OFFICER (A&T-I)  
For SECRETARY TO GOVERNMENT OF SINDH.