**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** |
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| ***Benchmark I****: Students will identify and analyze components of computer systems and different levels of interactions between hardware, software, users, and computer networks* | ***Benchmark I****: Students will identify and analyze logic gates in digital systems****Benchmark II****: Students will identify stages of system software development* ***Benchmark III:*** *Students will learn about scalability, reliability, and security of computer networks* |
| **Student Learning Outcome** |
| *[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.),*  | *[SLO CS-10-A-01] Students will be able to understand and describe number systems and encoding schemes for data representation in 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* | *[SLO CS-12-A-01] Students will explain the usability, security and accessibility of devices, the systems they are integrated with.* *[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*
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| *[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.* | *[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**[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.* | *[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* |  |
| *[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.* |  | *[SLO CS-11-A-03] Students will be able to understand and explain the scalability and reliability of networking systems via network topology**[SLO CS-11-A-04] Understand and explain the need for cybersecurity and contrast different methods of encryption to transmit data* | *[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* |

**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** |
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| **Benchmark I**: *Students will understand and apply computational thinking techniques to solve complex, real-world problems.* | **Benchmark I**: *Students have core concepts of basic data structures and algorithms used extensively in computer science and knowledge of how to apply these techniques toward solving more complex and real-life problems.* |
| **Student Learning Outcomes** |
| *[SLO CS-09-B-01] Understand and apply techniques to decompose problems* | *[SLO CS-10-B-01] Students will identify common algorithms used to develop software, store, search, or sort information*  | *[SLO CS-11-B-01] Plan, develop, systematically test, and refine computational artifacts for problem-solving such as pseudocode, etc.* | *[SLO CS-12-B-01] Understand and evaluate the computational solutions in terms of efficiency, clarity, and correctness* |
| *[SLO CS-09-B-02] Solve simple and complex problems computationally* | *[SLO CS-10-B-02] Develop and apply abstractions to create generalized, modular solutions* | *[SLO CS-11-B-02] Apply common search, and sort algorithms*  | *[SLO CS-12-B-02] Understand and apply complex algorithms on data structures such as trees and binary search* |

**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

| **Grade 9** | **Grade 10** | **Grade 11** | **Grade 12** |
| --- | --- | --- | --- |
| **Benchmark I**: *Students will develop, test, and debug static website (using HTML and CSS) and a dynamic website (using JavaScript)* | **Benchmark I**: *Students will develop, test, debug command-line interface (CLI) applications in Python* |
| **Student Learning Outcomes** |
| *[SLO CS-09-C-01] Students will understand web development and differentiate between a website and a web application* | *[SLO CS-10-C-01] Students should be able to differentiate between front-end development, and back-end development of a website* | *[SLO CS-11-C-01] Students should understand the importance of computer programming and applications*  | *[SLO CS-12-C-01] Students should be able to understand and evaluate applications of various programming paradigms.* |
| *[SLO CS-09-C-02] Students should be able to create a static website using HTML/CSS in an appropriate environment* *[SLO CS-09-C-03] Students should be able to create dynamic websites using JavaScript as the frontend scripting* | *[SLO CS-10-C-02] Students should be able to use more advanced HTML/CSS features in an appropriate environment**[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* |  *[SLO CS-11-C-02] Students should be able to write and execute simple programs in Python.**[SLO CS-11-C-03] Students should be able to draw shapes using Turtle Graphics functions in Python**[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.*  | *[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.* |
| *[SLO CS-09-C-04] Students should be able to implement common algorithms that use sequence, selection, and repetition in JavaScript* | *[SLO CS-10-C-04] Students should be able to implement complex algorithms that use more complex data structures (lists, etc.) in JavaScript* | *[SLO CS-11-C-05] Students should be able to translate simple algorithms that use sequence and repetition in Python.**[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.* | *[SLO CS-12-C-04] Students should be able to implement complex algorithms that use lists etc. in Python* |
| *[SLO CS-09-C-05] Students will determine ways of debugging their code in JavaScript* | *[SLO CS-10-C-05] Students will determine more advanced techniques (unit tests, breakpoints, watches) for testing and debugging their code in JavaScript* | *[SLO CS-11-C-07] Students will determine ways of debugging their code in Python* | *[SLO CS-12-C-05] Students will determine more advanced techniques (unit tests, breakpoints, watches) for testing and debugging their code in Python* |

**Domain D: Data and 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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| ***Benchmark I****: Students will be able to define and explain how to collect, store, analyze, visualize data* | ***Benchmark I****: 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** |
| --- | --- | --- | --- |
| ***Benchmark I****: Students learn about different popular fields in Computer Science like AI, Cloud Computing, IoT, and Blockchain.* | ***Benchmark I****: Students learn about different technologies that support the latest applications of CS and their relevance to Pakistan.****Benchmark II****: Students learn about data techniques in AI applications and the social implications of technology.* |
| **Student Learning Outcome** |
| *[SLO CS-09-E-01] Students will be able to describe uses and applications of computing like AI, Machine Learning, and Cloud Computing* | *[SLO CS-10-E-01] Students will be able to describe uses and applications that are enabled by technologies like IoT, and Blockchain*  | *[SLO CS-11-E-01] Students should be able to describe technologies that are the foundations of IoT systems, Cloud Computing, and Blockchain* | *[SLO CS-12-E-01] Students should be able to design ideas of applications relevant to Pakistan using IoT, Cloud computing, and Blockchain* |
|  | *[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.* |  | *[SLO CS-12-E-02] Students should be able to describe deep learning and its applications* |
| *[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* | *[SLO CS-10-E-03] Students will be able to demonstrate the social implications of AI* | *[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.*  | *[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.*  |

**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 for the modern world.

| **Grade 9** | **Grade 10** | **Grade 11** | **Grade 12** |
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| **Benchmark I**: *Students will obtain knowledge of ethical and legal issues surrounding the use of computing.* **Benchmark II**: *Students will understand privacy and network security issues surrounding computing applications and devices they use everyday* **Benchmark III**: *Students will understand the role of assistive technologies and understand the implications of the digital divide* | **Benchmark I**: *Students will interpret documents related to computing systems and evaluate their legal and ethical implications.***Benchmark II**: *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***Benchmark III**: *Students will demonstrate their ability to collaborate and communicate on the design of computing applications*  |
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| **Student Learning Outcomes** |
| *[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.)* | *[SLO CS-10-F-01] Understand and apply safe & responsible use of the internet to prevent addiction, promote information and data security*  | *[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* | *[SLO CS-12-F-01] Identify and apply safe practices when collaborating on digital or online platforms.* |
| *[SLO CS-09-F-02]**Analyze the beneficial and harmful effects of computing innovations such as social networking, fake news, etc.* | *[SLO CS-10-F-02] Evaluate the impact of and apply strategies to prevent cyberbullying/harassment* |  | *[SLO CS-12-F-02] Discuss security threats and mitigation such as 2FA, biometric verification, and secure techniques for transmitting data etc.* |
| *[SLO CS-09-F-03] Evaluate the ways computing impacts personal, ethical, social, economic, and cultural**practices* | *[SLO CS-10-F-03] Analyze the impacts of the digital divide on access to critical information* | *[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* | *[SLO CS-12-F-03] Collaborate on strategies to provide equity and equal access to information* |

**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** |
| --- | --- | --- | --- |
| **Benchmark I**: *Collect & analyze information and publish to various audiences using digital tools and media-rich resources.*   | **Benchmark I**: *Use digital tools to design and develop a significant digital artefact through research design, data collection, and communication.*  |
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| **Student Learning Outcomes** |
|  | *[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* | *[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)* | *[SLO CS-12-G-01] Students will create an artifact that answers a research question, communicates results and conclusions through digital resources or tools* |

**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** |
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| **Benchmark:** Students will learn how to identify problems and create and present business solutions | ***Benchmark:*** Students will learn how to build successful products or services by creating and testing prototype and launching a minimum viable product |
| **Student Learning Outcomes** |
| *[SLO EN-09-H-01]: Students identify a problem and create a business idea using design thinking* | *[SLO EN-10-H-01]: Students will use digital tools to conduct research to collect market and customer insights for a business idea* | *[SLO EN-11-H-01]: Students will create, test, and iterate a prototype for a business idea* | *[SLO EN-12-H-01]****:*** *Students will create and test a minimum viable product for their business* |
| *[SLO EN-09-H-02]****:*** *Students will use digital tools to create and present a business plan* | *[SLO EN-10-H-02]****:*** *Students will pitch a business idea* |  |  |

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