2023 Software Development

Program CIP: 11.0202 — Computer Programming, Specific Applications

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The Research and Curriculum Unit (RCU), located in Starkville, as part of Mississippi State University (MSU), was established to foster educational enhancements and innovations. In keeping with the land-grant mission of MSU, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances the intellectual and professional development of Mississippi students and educators while applying knowledge and educational research to the lives of the people of the state. The RCU works within the contexts of curriculum development and revision, research, assessment, professional development, and industrial training.

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Acknowledgments

The Software Development curriculum was presented to the Mississippi State Board of Education on February 16, 2023. The following persons were serving on the state board at the time:

Dr. Robert Taylor, state superintendent of education
Ms. Rosemary G. Aultman, chair
Mr. Glen East, vice chair
Dr. Karen Elam
Mrs. Mary Werner
Dr. Ronnie McGehee
Dr. Wendi Barrett
Mr. Matt Miller
Mr. Bill Jacobs
Ms. Micah Hill
Mr. Charlie Fruge'

Standards

Standards and alignment crosswalks are referenced in the appendix. Depending on the curriculum, these crosswalks should identify alignment to the standards mentioned below, as well as possible related academic topics as required in the Subject Area Testing Program in Algebra I, Biology I, English II, and U.S. History from 1877, which could be integrated into the content of the units. Mississippi's CTE Software Development curriculum is aligned to the following standards:

College- and Career-Readiness Computer Science Standards
College- and career-readiness standards emphasize critical thinking, teamwork, and problem-solving skills. Students will learn the skills and abilities demanded by the workforce of today and the future. Mississippi adopted Mississippi College- and Career-Readiness Standards (MCCRS) to provide a consistent, clear understanding of what students are expected to learn and so teachers and parents know what they need to do to help them.
mdek12.org/sites/default/files/Offices/MDE/OAE/SEC/2018_MCCRS_CS.pdf

Framework for 21st Century Learning
In defining 21st-century learning, the Partnership for 21st Century Skills has embraced key themes and skill areas that represent the essential knowledge for the 21st century: global awareness; financial, economic, business, and entrepreneurial literacy; civic literacy; health literacy; environmental literacy; learning and innovation skills; information, media, and technology skills; and life and career skills.
battelleforkids.org/networks/p21/frameworks-resources

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Preface

Secondary CTE programs in Mississippi face many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing applied learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments. This document provides information, tools, and solutions that will aid students, teachers, and schools in creating and implementing applied, interactive, and innovative lessons. Through best practices, alignment with national standards and certifications, community partnerships, and a hands-on, student-centered concept, educators will be able to truly engage students in meaningful and collaborative learning opportunities.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, *Mississippi Code of 1972*, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, Ch. 487, §14; Laws, 1991, Ch. 423, §1; Laws, 1992, Ch. 519, §4 eff. from and after July 1, 1992; Strengthening Career and Technical Education for the 21st Century Act, 2019 [Perkins V]; and Every Student Succeeds Act, 2015).

Mississippi Teacher Professional Resources

The following are resources for Mississippi teachers:

      Curriculum, Assessment, Professional Learning
            Program resources can be found at the RCU's website, rcu.msstate.edu.
            Additional resources can be found on the CS4MS website cs4ms.org
      Learning Management System: An Online Resource
            Learning management system information can be found at the RCU's website, under Professional Learning.

Should you need additional instructions, contact the RCU at 662.325.2510 or helpdesk@rcu.msstate.edu.

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Executive Summary

Pathway Description
Software development is a pathway in the field of computer science. The goal of this pathway is to offer a sequence of courses that provide rigorous content aligned with standards relevant to students interested in the software development industry. The skills gained in this pathway will enhance students' programming skills and knowledge of software development process and life cycle. Students will gain an understanding of how websites, databases, and programming work together to produce an application that meets the needs of the client and the user.

College, Career, and Certifications
JavaScript Specialist (ciwcertified.com/ciw-certifications/web-development-series/javascript-specialist)
> Exam Objectives: ciwcertified.com/ciw-certifications/web-development-series/javascript-specialist/exam-objectives

PCEP™ – Certified Entry-Level Python Programmer (pythoninstitute.org/pcep)
> Exam Objectives: pythoninstitute.org/pcep-exam-syllabus
> Study Resource: pythoninstitute.org/python-essentials-1

Grade Level and Class Size Recommendations
It is recommended that students participate in this program as 10th-12th graders. Exceptions to this are a district-level decision based on class size, enrollment numbers, student maturity, and CTE delivery method. This is a classroom-based course. Therefore, a maximum of 25 students is recommended for each class, with only one class with the teacher at a time.

Student Prerequisites
For students to experience success in the program, the following student prerequisites are suggested:

1. C or higher in English (the previous year)
2. C or higher in high school-level math (last course taken or the instructor can specify the level of math instruction needed)
3. Instructor approval and Test of Adult Basic Education (TABE) reading score (eighth grade or higher)

    or

1. TABE reading and math score (eighth grade or higher)
2. Instructor approval

    or

1. Instructor approval

Assessment
Year 1 Assessment: JavaScript Specialist (ciwcertified.com/ciw-certifications/web-development-series/javascript-specialist)
> Exam Objectives: ciwcertified.com/ciw-certifications/web-development-series/javascript-specialist/exam-objectives

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Year 2 Assessment: PCEP™ – Certified Entry-Level Python Programmer
(pythoninstitute.org/pcep)
Exam Objectives: pythoninstitute.org/pcep-exam-syllabus
Study Resource: pythoninstitute.org/python-essentials-1

Applied Academic Credit

The latest academic credit information can be found at
mdek12.org/ese/approved-course-for-the-secondary-schools.

Teacher Licensure

The latest teacher licensure information can be found at
mdek12.org/oel/apply-for-an-educator-license.

Professional Learning

If you have specific questions about the content of any training sessions provided, please contact
the RCU at 662.325.2510 or helpdesk@rcu.msstate.edu.

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Course Outlines

Four 1-Carnegie Unit Courses

This curriculum consists of four 1-credit courses. Below is the recommended sequence of courses for this pathway; therefore, the year 1 assessment is JavaScript, and the year 2 assessment is Python. However, since this pathway is often offered as a dual-credit option with a local community college, there is flexibility in the course and exam sequence based on the community college schedule.

1. **Web and Programming Concepts—Course Code: 902147**
2. **Client-side Programming—Course Code: 902148**
3. **SQL Programming—Course Code: 902105**
4. **Python I—Course Code: 902110**

Course Description: Web and Programming Concepts
This course will teach students the fundamentals of website development using HTML and CSS. At the end of the course, students will be able to design and create a website from scratch containing hyperlinks, images, tables, and forms.

Course Description: Client-side Programming
This course serves as an introduction to JavaScript and reinforcement of web development concepts. At the end of this course, students will be able to add interactive elements to websites using JavaScript variables, control structures, forms, and cookies.

Course Description: SQL Programming
This course serves as an introduction to SQL databases. Students will learn fundamentals of database design and interaction using SQL. Upon completion of this course, students will be able to design and create a SQL database with tables and views, use queries to select simple and complex information from the database, and set up roles and constraints on the database for proper data management.

Course Description: Python I
This course will teach students the fundamentals of the Python programming language. At the end of the course, students will be able to write Python scripts that will utilize input and output, control structures, data collections, and object-oriented programming techniques.

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Web and Programming Concepts—Course Code: 902147

Unit	Unit Title	Hours
1	Orientation and Ongoing Skills	10
2	Introduction to Web Programming, HTML, and Layout	40
3	Hyperlinks, Graphical Elements, Image Techniques, and Navigation Concepts	20
4	Tables and Forms	10
5	Cascading Style Sheets (CSS)	30
6	Capstone – Web and Programming Concepts	30
Total		**140**

Client-side Programming—Course Code: 902148

Unit	Unit Title	Hours
7	JavaScript Fundamentals	45
8	Control Structures, Events, Forms, and Security	80
9	Capstone – Client-Side Programming	15
Total		**140**

SQL Programming—Course Code: 902105

Unit	Unit Title	Hours
10	Fundamentals of SQL	75
11	Group Function Aggregation	10
12	Create, Manage, and Display Data	10
13	Constraints and Views	10
14	Database Objects and User Access	10
15	Capstone - SQL Programming	25
Total		**140**

Python I—Course Code: 902110

Unit	Unit Title	Hours
16	Fundamentals of Python	70
17	Data Handling	30
18	Object-Oriented Programming	20
19	Capstone – Python I	20
Total		**140**

Career Pathway Outlook

Overview

According to the State Workforce Investment Board (SWIB) Data Center, software developer (applications and software) occupations are projected to grow at 26.46% statewide. Median annual income for this occupation is $80,629.12 at a state level.

Despite the rise of no-code and low-code platforms which are disrupting some of the software industry, there will always be a need for people who are capable of reading and writing code. The future workforce will see software developers working closely in collaboration with engineers, data scientists, software architects, and business units.

Needs of the Future Workforce

Data for this synopsis were compiled from the Mississippi Department of Employment Security (MDES) (2022). Employment opportunities for each of the occupations are listed below:

Table 1.1: Current and Projected Occupation Report

Description	Jobs, 2018	Projected Jobs, 2028	Change (Number)	Change (Percent)	Average Yearly Earnings, 2022
Computer and Information Systems Manager	1,220	1,330	110	9.0%	$110,720
Computer and Information Research Scientists	350	350	0	0%	$101,050
Computer Programmers	960	910	-50	(5.2%)	$65,630
Software Developers	980	1,010	30	3.1%	$85,590
Web Developers	340	390	50	14.7%	$85,590
Computer Occupations, All other	720	750	30	4.2%	$81,320

Source: Mississippi Department of Employment Security; mdes.ms.gov (2022)

Perkins V Requirements and Academic Infusion

The Software Development curriculum meets Perkins V requirements of introducing students to and preparing them for high-skill, high-wage occupations in software development fields. It also offers students a program of study, including secondary, postsecondary, and institutions of higher learning courses, that will further prepare them for computing careers. Additionally, this curriculum is integrated with academic college- and career-readiness standards. Lastly, it focuses on ongoing and meaningful professional development for teachers as well as relationships with industry.

Transition to Postsecondary Education

The latest articulation information for secondary to postsecondary can be found at the Mississippi Community College Board website, mccb.edu.

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Best Practices
Innovative Instructional Technologies
Classrooms should be equipped with tools that will teach today's digital learners through applicable and modern practices. The software developer educator's goal should be to include teaching strategies that incorporate current technology. To make use of the latest online communication tools—wikis, blogs, podcasts, and social media platforms, for example—the classroom teacher is encouraged to use a learning management system that introduces students to education in an online environment and places more of the responsibility of learning on the student.

Differentiated Instruction
Students learn in a variety of ways, and numerous factors—students' background, emotional health, and circumstances, for example—create unique learners. By providing various teaching and assessment strategies, students with various learning preferences can have more opportunities to succeed.

CTE Student Organizations
Teachers should investigate opportunities to sponsor a student organization. There are several here in Mississippi that will foster the types of learning expected from the Software Development curriculum. The Technology Student Association (TSA) and Future Business Leaders of America (FBLA) are examples of student organizations that offer events within this field of study. Student organizations provide participants and members with growth opportunities and competitive events. They also open the doors to the world of computing careers and scholarship opportunities.

Cooperative Learning
Cooperative learning can help students understand topics when independent learning cannot. Therefore, you will see several opportunities in the Software Development curriculum for group work. To function in today's workforce, students need to be able to work collaboratively with others and solve problems without excessive conflict. The Software Development curriculum provides opportunities for students to work together and help each other complete complex tasks. There are many field experiences within the Software Development curriculum that will allow and encourage collaboration with professionals currently in the software development field.

Work-Based Learning
Work-based learning is an extension of understanding competencies taught in the software development classroom. This curriculum is designed in a way that necessitates active involvement by the students in the community around them and the global environment. These real-world connections and applications link all types of students to knowledge, skills, and professional dispositions. Work-based learning should encompass ongoing and increasingly more complex involvement with local companies and software development professionals. Thus, supervised collaboration and immersion into the software development industry around the students are keys to students' success, knowledge, and skills development.

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Professional Organizations

Association for Computing Machinery (ACM)
https://www.acm.org

Computer Science Teachers Association (CSTA)
https://www.csteachers.org

Institute of Electrical and Electronics Engineers (IEEE)
https://www.ieee.org

Using This Document

Competencies and Suggested Objectives
A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies. The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.

Teacher Resources
All teachers should request to be added to the Canvas Resource Guide for their course. For questions or to be added to the guide, send a Help Desk ticket to the RCU by emailing helpdesk@rcu.msstate.edu.

Perkins V Quality Indicators and Enrichment Material
Some of the units may include an enrichment section at the end. This material will greatly enhance the learning experiences of students. If the software development program is using a national certification, work-based learning, or another measure of accountability that aligns with Perkins V as a quality indicator, this material could very well be assessed on that quality indicator. It is the responsibility of the teacher to ensure all competencies for the selected quality indicator are covered throughout the year.

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Unit 1: Orientation and Ongoing Skills

Competencies and Suggested Objectives

1. Identify school policies and safety procedures related to the software development pathway. [DOK1]
   a. Examine the school handbook, the acceptable-use policy for technology, and other safety procedures for building-level situations.
   b. Preview the course outline and its relevance in today's workforce.
   c. Recognize appropriate safety measures related to technology in the computer lab and online safety such as phishing, other sources of viruses, malware, etc.
   d. Explore legalities and ethical use of various computational artifacts and resources.

2. Recognize opportunities to participate in student organizations related to technology and computer science. [DOK1]
   a. Identify student organizations available at school for technology and computer science.
   b. List student competitions available through each organization.

3. Demonstrate knowledge of 21st-century skills. [DOK4]
   a. Demonstrate effective collaboration and teamwork.
   b. Demonstrate creativity and imagination.
   c. Utilize critical thinking through effective reasoning, making judgements, and decisions.
   d. Execute problem-solving techniques.
   e. Demonstrate proper email etiquette.
   f. Demonstrate effective communication in groups.
   g. Demonstrate presentation skills.

4. Explore career opportunities within computer science in the specialty areas of programming, cybersecurity, data science, robotics, artificial intelligence, human-computer interaction, and web development. [DOK 3]
   a. Research career opportunities for employment in each of the specialty areas listed above.
   b. Examine the requirements, skills, wages, education, and employment opportunities in each of the specialty areas listed above.
   c. Describe how at least one of the specialty areas listed above is used in a career field outside of computer science (e.g., automotive, health care, fashion design, etc.).

5. Examine code and utilize debugging techniques to identify errors. [DOK3]
   a. Work together in a team to investigate code.
   b. Provide recommendations to correct or improve.

Note: Safety is to be taught as an ongoing part of the program. Students are required to complete a written safety test with 100% accuracy before entering the shop for lab simulations and projects. This test should be documented in each student's file.

Note: This unit will be ongoing throughout the program. Time allotted for this unit will be distributed over the entire program.

Unit 2: Introduction to Web Programming, HTML, and Layout

Competencies and Suggested Objectives

1. Explore the creation of a web page using Hypertext Markup Language (HTML) and/or Extensible Hypertext Markup Language (XHTML). [DOK3]
   a. Explain web page creation, discussing web browsers, standards, and accessibility.
   b. Contrast text editors and graphical user interface (GUI) editors.
   c. Explain HTML and XHTML and the standards of each.

2. Research the governing bodies that set standards for the internet. [DOK2]
   a. Explain the internet governing bodies.
   b. Discuss the Internet Society and Internet Architecture Board (IAB).
   c. Describe the Internet Research Task Force (IRTF) and Internet Engineering Task Force (IETF).
   d. Discuss the World Wide Web Consortium (W3C), Internet Corporation for Assigned Names and Numbers (ICANN), and Request for Comments (RFC).

3. Demonstrate web page layout and elements. [DOK4]
   a. Demonstrate an effective layout for a web page (e.g., wire frames and site maps).
   b. Discuss color and web design.
   c. Explore font usage.
   d. Explain website usability testing.

4. Explain HTML and/or XHTML. [DOK2]
   a. Explain markup tags.
   b. Discuss and use document structure tags.
      • Explore sectioning.
      • Explore grouping elements (e.g., unordered, ordered, and definition lists, etc.).
      • Explore text-level elements.
   c. Use comments and good coding practices (emphasizing readability).

Unit 3: Hyperlinks, Graphical Elements, Image Techniques, and Navigation Concepts

Competencies and Suggested Objectives

1. Demonstrate the use of hyperlinks. ^{DOK4}
   a. Explain and code hyperlinks.
   b. Use image and internal links.
   c. Explain the elements of navigation design.
   d. Demonstrate primary and secondary navigation.
   e. Discuss navigation hierarchy.
   f. Discuss site structure, uniform resource locators (URLs), and file names.
   g. Discuss familiar navigation conventions.

2. Use graphical elements to enhance a web page. ^{DOK4}
   a. Explain and use the horizontal rule.
   b. Discuss image and the use of them in a web page.
   c. Discuss image file formats and explain image optimization.
   d. Discuss and implement colors and the web-safe color palette.
   e. Explain special characters using character codes.
   f. Use page colors and backgrounds.
   g. Create image maps.
   h. Explain interlacing.
   i. Discuss the use of animated GIF images.

Unit 4: Tables and Forms

Competencies and Suggested Objectives

1. Demonstrate the use of tables. ^{DOK4}
   a. Create tables using tags.
   b. Use table and data alignment options.
   c. Explain and use column and row spanning.

2. Construct forms. ^{DOK4}
   a. Describe form uses and form fields.
   b. Create forms using various form controls.

Unit 5: Cascading Style Sheets (CSS)

Competencies and Suggested Objectives
1. Examine basic CSS techniques. DOK2
a. Discuss the history of CSS.
b. Discuss basic CSS components and rules.
2. Demonstrate cascading style sheets. DOK4
a. Use CSS language to build a web page.
b. Apply selection techniques.
c. Incorporate fonts into a web page using various methods such as @import.
d. Apply the CSS box model.
e. Use color in CSS.
f. Compare and contrast embedded, inline, and external styles.
g. Build a basic style sheet.
h. Apply CSS to lists.
i. Apply CSS to tables.
j. Apply CSS to positioning elements.

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Unit 6: Capstone – Web and Programming Concepts

Competencies and Suggested Objectives

1. Using software tools and programming skills learned in this course, apply the software development life cycle (SDLC) process to solve a student-selected, instructor approved industry/community relevant problem (Individual, small group, or large group). DOK4
  a. Research a problem that can be developed into an appropriate and manageable project.
  b. Create a project proposal that must be approved by the instructor before beginning the project.
  c. Use the SDLC process, including pseudocode and wireframes, to plan, design, develop, test, and implement the project.
  d. Utilize graphs, charts, and tables to analyze and display the data.
  e. Follow technical writing guides to convey project data and results.
  f. Develop the project in a way that can be easily shared with others so they can retrace steps and build on successes.
  g. Demonstrate effective interpersonal communication skills in a team or professional setting.
  h. Explore different development models such as agile, waterfall, spiral, etc. and choose one for the project.

2. Implement Planning and Design Phase of the SDLC. DOK4
  a. Gather project requirements and define the scope of the project.
  b. Using appropriate tools and materials, create a wireframe or prototype while considering the project requirements (e.g., accessibility, reliability, aesthetics, and the user experience).
  c. Create pseudocode to outline the project.
  d. Identify tasks and timeline to complete the project.
  e. Create a project management schedule to track progress and ensure completion.
  f. Discuss and utilize various project management tools (e.g., virtual meetings, shared documents, Gantt charts, software applications, etc.).
  g. Plan for and conduct mid-project check-ins.

3. Implement Development Phase of SDLC. DOK4
  a. Build a layout and implement functionality.
  b. Utilize peer code reviews.

4. Implement Test Phases of SDLC. DOK4   a. Simulate process of user acceptance testing and quality assurance testing.

5. Present and justify a final product to an authentic audience. [DOK4]
   a. Produce professional quality technical documents satisfying criteria listed in the assignment.
   b. Using appropriate technology and professional manner, present project elements to an authentic audience.
   c. Collect the following work materials in a portfolio to demonstrate proper use of the design process.
      - Project requirements
      - Wire frames
      - Pseudocode
      - Product specifications
      - Testing methodologies and results
      - Technical writing samples

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Unit 7: JavaScript Fundamentals

Competencies and Suggested Objectives

1. Explore client-side programming with JavaScript fundamentals. DOK3
   a. Explain scripting languages.
   b. Discuss JavaScript versus other languages.
   c. Discuss client-side versus server-side programming.
   d. Demonstrate embedding in HTML.

2. Explore client-side programming by examining the document object model (DOM). DOK3
   a. Identify and apply properties and/or methods of the following:
      • Window object
      • Location object
      • History object
      • Navigator object
      • Document object

3. Demonstrate client-side programming with JavaScript variables and data. DOK4
   a. Demonstrate communicating with the user.
   b. Explain variables and scopes.
   c. List keywords and reserved words.
   d. Discuss expressions and operators.
   e. Discuss inline scripting, user events, and the onLoad and onUpload event handlers.

4. Demonstrate client-side programming by debugging JavaScript. DOK4
   a. Use debugging tools.
   b. Discuss debugging techniques.

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Note: This unit will be ongoing throughout the program. Time allotted for this unit will be distributed over the entire program.

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Unit 8: Control Structures, Events, Forms, and Security

Competencies and Suggested Objectives

1. Apply control structures and statements. ^{DOK4}
   a. Apply decision statements using conditionals.
   b. Apply repetition statements using loops.

2. Utilize functions, methods, and events. ^{DOK4}
   a. Compare functions and methods.
   b. Apply concepts by defining and calling functions.
   c. Use event handlers.

3. Examine forms. ^{DOK2}
   a. Discuss form validation.
   b. Validate form data.

4. Discuss cookies and security. ^{DOK2}
   a. Explain the state information as it relates to cookies.
   b. Describe query strings, data sanitation, and injection vulnerabilities.
   c. Use cookies to capture save state information.
   d. Discuss JavaScript vulnerabilities.
   e. Define cross-site scripting and the associated security risks.

Unit 9: Capstone – Client-Side Programming

Competencies and Suggested Objectives

1. Using software tools learned, apply the software development life cycle (SDLC) process to solve a student-selected, instructor approved industry/community relevant problem (Individual, small group, or large group). DOK4
     a. Research a problem that can be developed into an appropriate and manageable project.
     b. Create a project proposal that must be approved by the instructor before starting the project.
     c. Use SDLC process including pseudocode and wire frames to plan, design, develop, test, and implement a project.
     d. Utilize graphs, charts, and tables to analyze and display the data.
     e. Follow technical writing guides to convey project data and results.
     f. Develop the project in a way that can easily be shared with others so that they can retrace steps and build on successes.
     g. Demonstrate effective interpersonal communication skills in a team or professional setting.
     h. Explore different development models and choose one for project (agile, waterfall, spiral, etc.).

2. Implement Planning and Design Phase of SDLC. DOK4
     a. Gather project requirements and define the scope of the project.
     b. Using appropriate tools and materials, create a wireframe or prototype while considering project requirements (e.g., accessibility, reliability, aesthetics, user experience).
     c. Create pseudocode to outline the project.
     d. Identify tasks and timeline to complete the project.
     e. Create a project management schedule to track progress and ensure completion.
     f. Discuss and utilize various project management tools (e.g., virtual meetings, shared documents, Gantt chart, software applications, etc.).
     g. Plan for, and conduct, mid-project check-ins.

3. Implement Development Phase of SDLC. DOK4
     a. Build a layout and implement functionality.
     b. Utilize peer code reviews.

4. Implement Test Phases of SDLC. DOK4   a. Simulate process of user acceptance testing and quality assurance testing.

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5. Present and justify a final product to an authentic audience. [DOK4]
    a. Produce professional quality technical documents satisfying criteria listed in assignment.
    b. Using appropriate technology and professional manner, present project elements to an authentic audience.
    c. Collect the following work materials in a portfolio to demonstrate proper use of the design process to include:
        - Project requirements
        - Wire Frames
        - Pseudocode
        - Product specifications and analysis
        - Testing methodologies and results
        - Technical writing samples

Enrichment

1. Research advantages and disadvantages of various JavaScript frameworks (e.g., Angular, React, Node.js, etc.).
2. Utilize one framework into the overall capstone project.
3. Update documentation, portfolio, and presentation materials to demonstrate use and knowledge of the framework.

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Note: This unit will be ongoing throughout the program. Time allotted for this unit will be distributed over the entire program.

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Unit 10: Fundamentals of SQL

Competencies and Suggested Objectives
1. Explore the need for databases in modern society. ^{DOK2}
a. Explain the need for and benefit of organizing individual pieces of data.
b. Explore the basic functions of a Database Management System.
c. Discuss potential causes of inaccurate data (e.g., inconsistencies, redundancy, integrity, dependence).
2. Write basic SQL statements and normalization. ^{DOK4}
a. Explore the capabilities of SQL SELECT statements.
b. Execute basic SELECT statements.
c. Use tools that recognize and submit SQL statements for processing.
d. Organize data into queryable tables through the use of normalization.
3. Restrict and sort data and use single-row functions. ^{DOK4}
a. Limit the rows retrieved by a query.
b. Sort the rows retrieved by a query.
c. Describe the various types of functions available in SQL.
d. Use character, number, date functions, and conditional expressions.
e. Use comparison operators and logical operators.
f. Use range conditions, membership conditions, and pattern matching.
g. Discuss rules of precedence.
4. Demonstrate displaying data from multiple tables. ^{DOK4}
a. Write SELECT statements to access data from more than one table.
b. Describe the Cartesian product.
c. Compare and use types of joins.
5. Construct subqueries. ^{DOK4}
a. Identify the types of problems that subqueries can solve.
b. Describe subqueries.
c. List the types of subqueries.
d. Write single-row and multiple-row subqueries.

Unit 11: Group Function Aggregation

Competencies and Suggested Objectives

1. Aggregate data using group functions. [DOK4]
    a. Identify the available group functions.
    b. Discuss the uses of group functions.
    c. Demonstrate the grouping of data and include or exclude grouped rows.

Unit 12: Create, Manage, and Display Data

Competencies and Suggested Objectives

1. Produce readable output and manipulate data in the database. [DOK4]
    a. Produce queries requiring an input variable.
    b. Use tools to control environment.
    c. Create and execute script files.

2. Manipulate data in the database. [DOK4]
    a. Describe data manipulation commands.
    b. Insert rows into a table, update rows in a table, and delete rows from a table.
    c. Control database transactions.
    d. Discuss and implement read consistency.

3. Create and manage tables. [DOK4]
    a. Create tables.
    b. Describe the data types that can be used when specifying column definitions.
    c. Alter table definition.
    d. Delete, rename, and truncate tables.

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Unit 13: Constraints and Views

Unit 13: Constraints and Views

Competencies and Suggested Objectives
1. Use constraints. [DOK4]
a. Describe constraints.
b. Create and maintain constraints.
2. Create views. [DOK4]
a. Describe views and their uses.
b. Demonstrate how to create and delete a view.
c. Retrieve data through a view.
d. Alter the definition of a view.
e. Insert, update, and delete data through a view.
f. Discuss inline views.

Unit 14: Database Objects and User Access

Competencies and Suggested Objectives

1. Use various database objects. DOK4
   a. Manage database objects using a data dictionary.
   b. Create, maintain, and delete sequences.
   c. Create, maintain, and delete indexes.
   d. Create and delete private and public synonyms.

2. Control user access. DOK4
   a. Analyze the concepts of users and their roles and privileges.
   b. Practice creating users.
   c. Grant and revoke privileges.
   d. Create roles and grant privileges to roles.
   e. Change user passwords.

3. Explore security vulnerabilities as they apply to SQL. DOK4
   a. Explore SQL injections.
   b. Discuss binding variables.

4. Investigate big data. DOK3
   a. Summarize big data models.
   b. Make observations of importance of big data and analytics.
   c. Investigate ethical data usage and collection.
   d. Research big data and its impact on society.

Unit 15: Capstone – SQL Programming

Competencies and Suggested Objectives

1. Using database tools and skills learned, apply a Database Life Cycle (DBLC) to design a functioning database. DOK4
    a. Research a set of related information that would benefit from being organized into a database.
    b. Create a project proposal that must be approved by the instructor.
    c. Demonstrate effective interpersonal skills in a team or in a professional setting.

2. Conduct an initial database study and begin in the design process. DOK4
    a. Analyze and define the purpose, scope, and constraints of the database.
    b. Normalize the data.
    c. Design E-R diagrams.

3. Implement the design into a computerized database. DOK4
    a. Create multiple tables, add required data, and build relationships.
    b. Construct views, aggregate views, and subqueries using both single and multiple tables.
    c. Define user roles and permission levels.

4. Test and evaluate the database. DOK4
    a. Analyze the integrity of the data.
    b. Perform peer code reviews.
    c. Create a plan for maintenance (e.g., backup, recovery, enhancement, or structural changes).

5. Present and justify a final product to an authentic audience. DOK4
    a. Produce professional quality technical documents satisfying criteria listed in the assignment.
    b. Using appropriate technology and professional manner, present project elements to an authentic audience.
    c. Collect the following work materials in a portfolio to demonstrate proper use of the design process:
       • Project requirements
       • E-R diagrams
       • Short-hand notation
       • Product specifications and analysis
       • Testing methodologies and results
       • Technical writing samples

Enrichment
1. Research differences in various database management software.   2. Research integration technologies to implement online database access.

Note: Carefully moderate student's project topic to ensure a successful database.

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Unit 16: Fundamentals of Python

Competencies and Suggested Objectives
1. Describe proper programming techniques. ^{DOK4} a. Discuss Python terminology. b. Explore the syntax, logic, and structure of Python programs. c. Discuss readability through proper use of whitespace, indentation, and comments. d. Develop algorithms using pseudocode.
2. Use variables and data types. ^{DOK4} a. Declare variables and determine data types. b. Create expressions while following the proper order of operations.
3. Construct input and output statements. ^{DOK4} a. Manipulate strings. b. Format strings using f-strings. c. Add proper comments for documentation. d. Process user input and output. e. Debug using Python.
4. Apply control structures and statements to control program flow. ^{DOK4} a. Apply decision statements using conditionals. b. Apply repetition statements using loops.
5. Design programs using functions. ^{DOK4} a. Use function calls and built-in functions. b. Define functions using parameters. c. Call functions using arguments. d. Analyze, detect, and fix code segments that have errors. e. Analyze and construct code segments that handle exemptions.

Note: Safety is to be taught as an ongoing part of the program. Students are required to complete a written safety test with 100% accuracy before entering the shop for lab simulations and projects. This test should be documented in each student's file.

Note: This unit will be ongoing throughout the program. Time allotted for this unit will be distributed over the entire program.

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Unit 17: Data Handling

Competencies and Suggested Objectives
1. Apply concepts to process data. [DOK4]
a. Open, read, search, and write to files.
2. Analyze data collections. [DOK4]
a. Construct lists, tuples, and strings.
b. Manipulate mutable data collections.
c. Discuss dictionaries and sets.

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Unit 18: Object-Oriented Programming

Competencies and Suggested Objectives

1. Identify object-oriented programming. DOK2
   a. Discuss programs with classes.
   b. Discuss inheritance and recursion.

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Unit 19: Capstone – Python I

Competencies and Suggested Objectives

1. Using software tools and programming skills learned in this course, apply the software development life cycle (SDLC) process to solve a student-selected, instructor approved, industry and community relevant problem (Individual, small group, or large group). [DOK4]
   a. Research a problem that must be approved by the instructor before beginning the project.
   b. Use the SDLC process including pseudocode and wireframes to plan, design, develop, test, and implement the project.
   c. Utilize graphs, charts, and tables to analyze and display the data.
   d. Follow technical writing guides to convey project data and results.
   e. Develop the project in a way that can be easily shared with others so they can retrace steps and build on successes.
   f. Demonstrate effective interpersonal communication skills in a team or professional setting.
   g. Explore different development models such as agile, waterfall, spiral, etc. and choose one for the project.

2. Implement Planning and Design Phase of the SDLC. [DOK4]
   a. Gather project requirements and define the scope of the project.
   b. Using appropriate tools and materials, create a wireframe or prototype while considering the project requirements (e.g., accessibility, reliability, aesthetics, and the user experience).
   c. Create pseudocode to outline the project.
   d. Identify tasks and a timeline to complete the project.
   e. Create a project management schedule to track progress and ensure completion.
   f. Discuss and utilize various project management tools (e.g., virtual meetings, shared documents, Gantt chart, software applications, etc.).
   g. Plan for and conduct mid-project check-ins.

3. Implement Development Phase of SDLC. [DOK4]
   a. Build a layout and implement functionality.
   b. Utilize peer code reviews.

4. Implement Test Phases of SDLC. [DOK4]   a. Simulate process of user acceptance testing and quality assurance testing.

5. Present and justify a final product to an authentic audience. ^{DOK4}
a. Produce professional quality technical documents satisfying criteria listed in the assignment.
b. Using appropriate technology and professional manner, present project elements to an authentic audience.
c. Collect the following work materials in a portfolio to demonstrate proper use of the design process.

      - Project requirements
      - Wire frames
      - Pseudocode
      - Product specifications and analysis
      - Testing methodologies and results
      - Technical writing samples

Enrichment

1. Research third-party libraries, frameworks, and Application Programming Interfaces (API) that may benefit the overall objective of the project.
2. Utilize one or more libraries, frameworks, and/or APIs into the project.
3. Modify all supporting documentation, portfolio, and presentation materials to demonstrate knowledge and skills of the library framework and/or API.

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Student Competency Profile

Student's Name: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student, and it can serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Orientation and Ongoing Skills		
	1.	Identify school policies and safety procedure related to the software development pathway.
	2.	Recognize opportunities to participate in student organizations related to technology and computer science.
	3.	Demonstrate knowledge of 21st-century skills.
	4.	Explore career opportunities within computer science in the specialty areas of programming, cybersecurity, data science, robotics, artificial intelligence, human-computer interaction, and web development.
	5.	Examine code and utilize debugging techniques to identify errors.
Unit 2: Introduction to Web Programming		
	1.	Explore the creation of a web page using Hypertext Markup Language (HTML) and/or Extensible Hypertext Markup Language (XHTML).
	2.	Research the governing bodies that set standards for the internet.
	3.	Demonstrate web page layout and elements.
	4.	Explain HTML and/or XHTML.
Unit 3: Hyperlinks, Graphical Elements, Image Techniques, and Navigation Concepts		
	1.	Demonstrate the use of hyperlinks.
	2.	Use graphical elements to enhance a web page.
Unit 4: Tables and Forms		
	1.	Demonstrate the use of tables.
	2.	Construct forms.
Unit 5: Cascading Style Sheets (CSS)		

	1.	Examine basic CSS techniques.
	2.	Demonstrate cascading style sheets.

Unit 6: Capstone – Web and Programming Concepts

	1.	Using software tools and programming skills learned in this course, apply the software development life cycle (SDLC) process to solve a student-selected, instructor approved industry/community relevant problem (Individual, small group, or large group).
	2.	Implement Planning and Design Phase of the SDLC.
	3.	Implement Development Phase of SDLC.
	4.	Implement Test Phases of SDLC.
	5.	Present and justify a final product to an authentic audience.

Unit 7: JavaScript Fundamentals

	1.	Explore client-side programming with JavaScript fundamentals.
	2.	Explore client-side programming by examining the document object model (DOM).
	3.	Demonstrate client-side programming with JavaScript variables and data.
	4.	Demonstrate client-side programming by debugging JavaScript.

Unit 8: Control Structures, Events, Forms, and Security

	1.	Apply control structures and statements.
	2.	Utilize functions, methods, and events.
	3.	Examine forms.
	4.	Discuss cookies and security.

Unit 9: Capstone – Client-Side Programming

	1.	Using software tools learned, apply the software development life cycle (SDLC) process to solve a student-selected, instructor approved industry/community relevant problem (Individual, small group, or large group).
	2.	Implement Planning and Design Phase of SDLC.
	3.	Implement Development Phase of SDLC.
	4.	Implement Test Phases of SDLC.
	5.	Present and justify a final product to an authentic audience.

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Unit 10: Fundamentals of SQL		
	1.	Explore the need for databases in modern society.
	2.	Write basic SQL statements and normalization.
	3.	Restrict and sort data and use single-row functions.
	4.	Demonstrate displaying data from multiple tables.
	5.	Construct subqueries.
Unit 11: Group Function Aggregation		
	1.	Aggregate data using group functions.
Unit 12: Create, Manage, and Display Data		
	1.	Produce readable output and manipulate data in the database.
	2.	Manipulate data in the database.
	3.	Create and manage tables.
Unit 13: Constraints and Views		
	1.	Use constraints.
	2.	Create views.
Unit 14: Database Objects and User Access		
	1.	Use various database objects.
	2.	Control user access.
	3.	Explore security vulnerabilities as they apply to SQL.
	4.	Investigate big data.
Unit 15: Capstone – SQL Programming		
	1.	Using database tools and skills learned, apply a Database Life Cycle (DBLC) to design a functioning database.
	2.	Conduct an initial database study and begin in the design process.
	3.	Implement the design into a computerized database.
	4.	Test and evaluate the database.
	5.	Present and justify a final product to an authentic audience.
Unit 16: Fundamentals of Python		
	1.	Describe proper programming techniques.

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	2.	Use variables and data types.
	3.	Construct input and output statements.
	4.	Apply control structures and statements to control program flow.
	5.	Design programs using functions.
Unit 17: Data Handling		
	1.	Apply concepts to process data.
	2.	Analyze data collections.
Unit 18: Object-Oriented Programming		
	1.	Identify object-oriented programming.
Unit 19: Capstone – Python I		
	1.	Using software tools and programming skills learned in this course, apply the software development life cycle (SDLC) process to solve a student-selected, instructor approved industry and community relevant problem (Individual, small group, or large group).
	2.	Implement Planning and Design Phase of the SDLC.
	3.	Implement Development Phase of SDLC.
	4.	Implement Test Phases of SDLC.
	5.	Present and justify a final product to an authentic audience.

Appendix: Computer Science Standards

Framework for MCCRS for Computer Science Crosswalk for Software Development Pathway																				
	Units	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
Standards																				
AP.3A.1		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
AP.3A.2			X			X			X		X	X					X	X		
AP.3A.3			X				X		X	X							X			
AP.3A.4								X	X								X			
AP.3A.5		X					X	X		X						X	X			X
AP.3A.6			X				X	X	X	X		X	X		X	X	X	X		X
AP.3A.7							X			X						X				X
AP.3A.8		X																		
AP.3A.9			X				X			X										X
AP.3A.10		X					X			X						X				X
AP.3A.11			X	X		X	X			X						X			X	X

Level 3A: Algorithms and Programming (AP.3A)

AP.3A.1 Create prototypes that use algorithms to solve computational problems by leveraging prior student knowledge and personal interests.

AP.3A.2 Use lists and functions to simplify solutions, generalizing computational problems instead of repeatedly using simple variables.

AP.3A.3 Justify the selection of specific control structures when tradeoffs involve implementation, readability, and program performance, and explain the benefits and drawbacks of choices made.

AP.3A.4 Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue by using events to initiate instructions.

AP.3A.5 Decompose problems into smaller components through systematic analysis, using

constructs such as procedures, modules, and/or objects.

AP.3A.6 Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs.

AP.3A.7 Systematically design and develop programs for broad audiences by incorporating feedback from users.

AP.3A.8 Evaluate licenses that limit or restrict use of computational artifacts when using resources such as libraries.

AP.3A.9 Evaluate and refine computational artifacts to make them more usable and accessible.

AP.3A.10 Design and develop computational artifacts working in team roles using collaborative tools.

AP.3A.11 Document design decisions using text, graphics, presentations, and/or demonstrations in the development of complex programs.