Software Development CS BTech (SD) Program - Overview

There are two primary reasons why we send our children to university/college:

- So they become prepared for a sustainable career in a well-paying field.
- To develop them into happy, productive citizens capable of fully participating in their world.

MMU's new Software Development CS BTech (SD) Program has been carefully designed to produce such graduates. Here's how:

First, the new SD program's primary objective is to produce graduates who will be job-ready for a specific job-role: software developer with expertise in Java and 1-2 years of experience.

We begin by immersing our students into a simulated work environment where, from day one, they work on realistic projects to produce real industry deliverables using real industry processes and tools.

We know that our students will struggle with their assignments at first, so we mentor them with professionally trained faculty whose purpose and goal is to help the students succeed.

Students in the SD Program will get four years of on-the-job training, but in a safe environment where mistakes are lessons to be learned.

Of course, none of this would matter if the software industry is in decline, however it is not. Most projections for the software industry call for at least 50% growth in well-paying jobs requiring significant expertise over the foreseeable future.

The SD program focuses on the five things that a graduate needs to be job-ready for the entry-level software developer role:

- Knowledge
- Technical Skills
- Soft Skills, primarily communications skills in English
- Behavior Skills
- Experience

Students acquire each of these by working on realistic projects throughout their 4 years in the program, producing deliverables and receiving feedback on those deliverables from faculty.

From their project work students establish a portfolio of projects that they've worked on that they can share with hiring managers during placement, demonstrating the real-world experience they have acquired during their time in the SD program.

During the program students also receive training on behavior skills. We don't teach students how to behave, they learn that behavior has consequences. You choose your behavior, and you live with the consequences. From day 1 students work in small teams, forcing them to interact with others. We teach students how to improve their ability to navigate the world of human interaction through awareness and analysis of behavior, situation and context. In addition, students are mentored on their behavior by their faculty, as well as on the content, volume and

quality of their work.

We believe that the SD program is unique in helping students learn the importance of behavior skills, and how to use them effectively to cope in a variety of situations and contexts.

Finally, students are provided with an opportunity to learn and practice what are typically attributed to a liberal arts education such as logic, rhetoric, grammar, calculus, physics, public speaking and critical thinking, ensuring that they are prepared to play a role in modern society.

Our experience is that the combination of an immersive, project-based pedagogy combined with a focus on behavior and other critical thinking skills produces happy, well-adjusted and job-ready graduates who will be in demand by the software industry and who will be ready and eager to make their way as citizens in the world.

Physics I with Lab

Classroom	Labs	Credits: 4
3	1	

Physics I explores the basics of physical science: how to use hardware and software tools to measure basic observable phenomena, how to record, reason about, and draw logical conclusions from the data, and how to write up each of these properly so others can benefit from your work (e.g. make entries into an engineering notebook).

The goal of this class is to produce students good enough in Newtonian Physics to be able to work with a physicist who needs equations modeled/automated. Given the equations, the programmer should be able to figure out how to implement some models using a math tool like MatLab or Mathematica (we'll be using the free tool - Octave) or other programming languages as appropriate.

Units and Performance Objectives: Following are the various phenomena studied in this class:

- **Units, Measurements & Errors** – Fundamental physical quantities and base units, SI and other international systems of units, inter-conversion of units, measurement of lengths, triangulation method, parallax method, accuracy and precision, systematic errors, random errors, absolute & percentage errors, propagation of errors.
- **Motion Along a Straight Line** – Determining when an object acts as a point-like particle and when it must be treated as a collection of such particles; reason about a particle's initial location, its final location, displacement, and how displacement and final location may change over time.
- **Vectors** – Mathematical principles of commutative and associative laws help us measure, record, and reason about concepts such as position, velocity, and acceleration.
- **Motion in Two and Three Dimensions** – How vectors can be used to model particles in a two and three-dimension coordinate system and convert back and forth between the coordinate system's representation and the vector's.
- **Force and Motion** – Forces can be modeled as a vector and may be a collection of components. Newton's first and second laws give us insights about how to deal with real world issues such as the relationship between net force on an object, its mass, and acceleration. When we enhance the model by adding in friction, we need to distinguish between static and kinetic situations and consider the direction and magnitude of the frictional force. Understand the various situations and methods of determining the center of mass.
- **Kinetic Energy and Work** – Understand and apply the relationship between a particle's kinetic energy, mass, and speed.
- **Potential and Conservation of Energy** – Understand and apply the differences between a conservative and a non-conservative force, the important aspects of a conservative force, the gravitational potential energy in a particle-Earth system.

- **Angular Motion** – Given the understanding of the characteristics of a rigid body, identify the angular position of a specific rotating rigid body and an external reference line. Be able to apply the relationship between angular displacement and the initial and final angular positions as well as the average angular velocity, angular displacement, and the time interval for that displacement to solve problems. Given that smooth rolling is a combination of pure translation and pure rotation, apply the relationship between center-of-mass speed and the angular speed of a body to solve problems.
- **Oscillatory Motion and Waves** – Understand how simple harmonic motion is a part of the underlying physical phenomenon of modern day technology and hence study the basic concepts related to it, develop mathematical formulation to analyze and solve problems involving oscillatory motion, forced vibrations and damped oscillations
- **Waves** – Waves are central to communication technology. It is essential to understand the mathematics involved in analysis of different waveforms and hence to be able to model the case of waves on a string, derive expressions for speed and energy of waves and apply it other waves like sound and solve related problems.

Books:

- *Fundamentals of Physics*, *Volumes 1 & 2* by Halliday, Resnick and Walker. 10th edition

Calculus I

Classroom	Labs	Credits: 3
3	-	

Calculus I introduces the intuitive, numerical and theoretical concepts of limits, continuity, differentiation and integration. Students will study extrema, curve sketching, and applications involving algebraic, exponential, logarithmic and trigonometric functions. This course makes use of extensive use of GUI based software to solve problems. The intended audience of this course is CS majors specializing is software development.

Units and Performance Objectives: Following are the various topics studied in this class

- **Functions and Models** – Students become skilled working with functions as both abstract and applied real world models and can demonstrate how functions can be composed with others to develop new functions to solve more complex problems. Students will practice using computers and other tools to explore and more deeply understand these functions and the implications of these models in solving real-world problems.
- **Limits and Derivatives** – Students will be able to demonstrate an effective understanding the basics of limits (e.g. tangents, velocity problems), limits of functions, continuity, asymptotes, derivatives, rates of change, and derivatives as a function.
- **Differentiation Rules** – This unit explores the most commonly used differentiation rules that facilitate effective solutiosn to the more common real-work problems (e.g. polynomials, exponentials, product and quotient rules, trigonometric function rules, the Chain Rule). Students will explore these rules and through practice become skilled at using them.
- **Applications of Differentiation** – This unit build upon the foundation laid so far to support the common applications of these concepts and rules from the real world (e.g. minimums and maximums, the Mean Value Theorem, sketching curves, optimization problems).
- **Integrals** – The final unit of this class explores areas and distances, the Definite Integral, the Fundamental Theorem of Calculus, Indefinite Integrals, and the Substitution Rule).

Books: *Calculus: Early Transcendentals, International Metric Edition*. Stewart, James. Eighth Edition, ISBN-13: 978-1305266728

Computation & Problem Solving

Classroom	Labs	Credits: 3
3	-	

This class introduces students to problem-solving approaches and tools, professional communications and professional behavior. Students work in small groups to encourage collaboration and cross teaching, and to provide a background for introducing discussions and assignments on communications and behavior.

Performance Objectives: As a result of successfully completing this course, students will be able to:

- Model and solve problems using spreadsheets, simple spreadsheet macros and websites.
- Perceive scientific problem solving as a viable and exciting career that they can achieve and enjoy.
- Solve business problems through simple modeling and automation
- Use the Web to do basic research.
- Become self-aware of their own behavior and aware of how others perceive behavior.
- Behave appropriately in a professional environment, and understand the consequences of not behaving professionally.
- Create and deliver short, easy documents and presentations that are well organized, compelling and supported by evidence.
- Use appropriate tools and processes to develop, test and complete their projects.
- Interact, collaborate and communicate effectively with their instructors and fellow students.
- Give and receive 360-degree feedback.

In this class, students work on the following projects:

Effort Logging (using Spreadsheets). This project introduces students to cells and cell formulas, simple dashboards and data analysis.

There are three parts to the effort-logging project:

- Students log their individual effort in a spreadsheet created by a classmate.
- Students update their effort logging so that all members of their small team use the same spreadsheet to collect their daily effort data, producing reports and analyzing the resulting data.
- Students aggregate the data from their batch, producing reports and analyzing the data.

Develop a Personal Website. Students create simple, static, linked Web pages that contain personal information (picture, contact information, brief biography, hobbies and interests). This project introduces students to HTML and a simple HTML editor.

Develop a Customer Website. Students plan and implement a customer's oil well mapping Web application prototype using Google Maps. This project introduces students to basic data types and programming concepts using JavaScript and the Eclipse integrated development environment (IDE) editor.

Update Customer's Website. Students update their Customer Website by using cascading style sheets (CSS) to facilitate a consistent look and feel across the external customer's Web pages, and to make future website changes much quicker and easier to apply. A late change by the customer emphasizes the importance of using CSS since the change will be tedious and time consuming if each page needs to be modified manually.

Give and Receive 360-degree feedback. Students follow a process where they learn how to give and receive feedback about each other's behavior and performance in the class in a positive and professional manner.

In addition, students:

- Record information about their project work and experiments, capturing notes and other data and evidence about their work performed in an **Engineering Notebook**.
- Maintain their personal **Professional Portfolio**, which provides concrete evidence that shows what the student has actually done and can be used to convince employers that the students have the knowledge, skills, and capabilities they say they have.

Books: *Pro HTML5 with CSS, JavaScript, and Multimedia: Complete Website Development and Best Practices*, Mark. J Collins

Computer Science Professionalism

Classroom	Labs	Credits: 3
3	-	

This class provides a solid foundation of the most basic Computer Science and Software Development vocabulary, concepts, tools and ways of thinking, working, and behaving as we introduce and explore the concepts and behaviors of professionalism. This is accomplished by means of realistic work on several projects, the most significant being to help a client specify and design an innovative calculator for professionals working to produce spacecraft to explore Mars and mine the Asteroids.

Performance Objectives: As a result of successfully completing this course, students will be able to:

- Explore a topic, develop a simple taxonomy of the topic from credible sources, and explain the topic and the taxonomy.
- Properly use the basic vocabulary, concepts, and mental models of Computer Science to meaningfully discuss, in general, what distinguishes true professionals in software development from hackers and others who are just good programmers.
- Read, understand, and begin to use basic UML formalisms in the study of design documents and in communication with other software professionals.
- Discover and explain the basic consequences of simple design choices.
- Create useful Engineering Notebook entries and Mind Maps for both future reference and for documenting the creation of Intellectual Property.
- Discuss the pros and cons of various standard intellectual properties schemes and compellingly argue for both sides for each.
- Describe the relevance of various Computer Science sub-domains to modern professional work and why these are of societal importance.
- Begin to develop the ability to find information relevant to a task, evaluate the credibility of the source of the information, understand key aspects of the information, summarize that understanding, and effectively communicate that understanding to others.

In this class, students work on the following projects:

Science and Engineering Calculator Project for critical space mission professionals - The project has each intern working in small groups to explore the failure of the Mars Climate Orbiter (MCO) and the root causes of the failure. From this understanding and a video from a client, the students will work in small groups to develop and document the requirements for a suite of potential products, one of which is a calculator.

Professional Role Models in Software Development Web Site – To support current and future interns launch their careers, this project requires each student to find two role

models whose career provide insight and guidance on how the firms interns should go about their own career planning and implementation.

Intellectual Property Issues in Software Development – At a time of significant growth in software develop as a major economic force, many young professionals seem to feel that sharing of information and files is just a part of the new culture. Unfortunately, without some form of intellectual property rights, the creators of the bulk of this new economic growth will not earn a return on their investment and they will be forced to find other work. This project has the interns digging deeply into the issue, explore the pros and cons, and write up the results for others to consider.

In addition, students:

- Capture effort information about their project work in a spreadsheet **Effort Log.**
- Record information about their project work and experiments, capturing notes and other data and evidence about their work performed in an **Engineering Notebook**.
- Maintain their personal **Professional Portfolio**, which provides concrete evidence that shows what the student has actually done and can be used to convince employers that the students have the knowledge, skills, and capabilities they say they have.

Books: None

Communications I

Classroom	Labs	Credits: 3
3	-	

This college level writing class experience simulates a real-world business environment in which the student is expected to write compositions required various business scenarios. This class emphasizes identifying rhetorical modes, reading, planning, writing, and revising of compositions, including the development of critical and logical thinking skills. This class requires writing a minimum of five compositions that stress analytical, evaluative, and persuasive/argumentative writing, with at least one in-class presentation.

Performance Objectives:

- Write for different professional audiences using the appropriate voice and language in a given cultural context.
- Write a variety of business documents that aid in the search and application of jobs.
- Write paragraphs that use proper structure, function, order, and cohesion.
- Format a document in Microsoft Word and Google Docs using MLA documentation style.
- Follow the writing process, which involves brainstorming, outlining, drafting, revising, and editing, to create effective business communications.
- Participate in collaborative writing, revising, and editing, using Google Docs, with their classmates/teams.
- Read and analyze assigned scholarly and/or Web articles that present various arguments.
- Conduct online research using basic research skills.
- Use critical reading skills to identify key phrases and positions/attitudes of the job descriptions.
- Use rhetorical modes in writing and editing business documents.
- Set up a Twitter account and use its available tools to build a professional brand.
- Recognize the rhetorical functions of Twitter.
- Design a PowerPoint presentation using fundamental design and presentation skills.
- Create a presentation using screencast software.

In this class, students work on the following projects:

Prepare to Apply for a Job. The goal of this project is for the student to learn how to employ reading and writing strategies during the process of applying for a job. This project is divided into multiple tasks:

- Task 1: Students write an Informational Process letter to their management that describes their plan for applying for a job.

- Task 2: Students write an Operational Definition Argument on the meaning of key phrases from relevant job descriptions they find on industry job sites.
- Task 3: Students write their bio/cv/resume to get a clear idea of their current skill set so they can compare it to skills identified on industry job sites they would like to get and help establish their professional and personal goals.
- Task 4: Students write cover letters that will engage a hiring manager, including brief stories for each claim made in their cover letters.
- Task 5: Students identify criteria they will use to evaluate their strengths and weaknesses with regard to this project, and write a self-assessment letter that documents the results of their self-evaluation.

Market Yourself Professionally. The goal of Project 2 is for students learn how to write a well reasoned and researched position argument about an issue or controversy in the computer sciences, as well as establish their professional character (ethos) and brand-based on their position. This project is divided into multiple tasks:

- Task 1: The company asks the students to help it decide whether it should take on a new client based on the type of business the client is in. How should the student respond?
- Task 2: Students create their professional online presence to help them keep current in the software industry, to network and to engage in conversations with thought leaders, and to help with marketing when they are looking for new employment opportunities.
- Task 3: Students create a 'visual resume' to show why they should be hired and areas in which they excel.

In addition, students:

- Capture effort information about their project work in a spreadsheet **Effort Log.**
- Record information about their project work and experiments, capturing notes and other data and evidence about their work performed in an **Engineering Notebook**.
- Maintain their personal **Professional Portfolio**, which provides concrete evidence that shows what the student has actually done and can be used to convince employers that the students have the knowledge, skills, and capabilities they say they have.

Books:

- None

Physics II with Lab

Classroom	Labs	Credits: 4
3	1	

Physics II focuses on the application of knowledge and skills acquired in Physics I to other fields of physical sciences which drive the modern world:

- How to assess problems using appropriate conceptual frameworks
- How to solve problems by applying physical models
- How to investigate experimentally, how to measure and evaluate what we observe, and how to draw and communicate conclusions in a lucid way.

The primary objective is to understand the fundamentals of technology involved in the production of modern day state-of-the-art systems like communications systems, display technologies, microwave devices, etc., in order to write software which is effective, error free and flows logically.

Units and Performance Objectives: Following are the various phenomena studied in this class:

- **Electric Field and Potential** – Understand the nature and properties of electric charge, determine electric fields from given charge configurations, use Gauss' Law to determine fields from continuous charge distributions, and calculate potentials and electrostatic potential energies.
- **Electric Current and DC circuits** – Understand the basics of electric current, resistance, resistivity, solve problems of DC electric circuits and design circuits for specific purposes.
- **Charges in motion and Magnetic Field** – Establish relationship between moving charges and magnetic field, ascertain the genesis of magnetic fields, understand the underlying principles of some magnetic devices
- **Magnetic Materials & Earth's Magnetism** – Understand the magnetism in matter, apply the knowledge of earth's magnetism to develop navigation software, GPS, etc. Be able to explain the working of devices based on magnetic materials like computer data storage devices.
- **AC circuits and Electromagnetic Induction** – Understand and apply the concepts of alternating current and voltages that power up almost all of our electrical and electronic devices to design and troubleshoot real life circuits, understand the fundamental principles of electromagnetic induction and apply them to solve problems related to power generation
- **Electromagnetic Wave** – Gain insights into the backbone of modern communication systems for writing effective software for communication systems.
- **Interference & Diffraction Waves** – Identify phenomenon displayed solely by waves and calculate microscopic quantities like wavelengths and frequencies of light sources conveniently by applying concepts of interference and diffraction.

- **Laser and Optical Fiber** – Select appropriate equipment by applying knowledge of the types and characteristics of Lasers and Optical fibers.
- **Atoms & Nuclei** – The history of atoms dates back to 4^{th} century BC but could not gain traction till 17^{th} century due to inadequate experimental techniques. Here we revisit landmark theories and experiments to understand the properties and nature of atoms and nuclei, establish theories and apply them to calculate, predict and model various physical situations ranging from the atoms to stars, understand the phenomena like fission, fusion, mass defect, etc. and their applications to devices like nuclear reactors.

Books:

- *Fundamentals of Physics, Volumes 1 & 2* by Halliday, Resnick and Walker, 10th edition

Calculus II

Classroom	Labs	Credits: 3
3	-	

Calculus II continues the intuitive, practical, numerical and theoretical development of integration, inverse functions (exponential, logarithmic and inverse trigonometric functions), techniques of integration (e.g. integration by parts, integration using software tools, and other standard methods), and further applications of integration and modeling from the real world (including differential equations, parametric equations, and polar coordinates). This course makes use of extensive use of GUI based software to solve problems. The intended audience of this course is CS majors specializing in software development.

Performance Objectives:

- **Applications of Integration** – Students will become skilled working with applied real world applications. Students will practice using computers and other tools to explore and more deeply understand integration and the implications of using these tools in solving real-world problems.
- **Inverse Functions** – Students continue to explore exponential, logarithmic and inverse trigonometric functions and their applications in the real world.
- **Techniques and Further Application of Integration** – This unit furthers the applicability of integration by means of the standard techniques, such as integration by parts, trigonometric integrals, and how various computer libraries and tools enable practical solutions to more complex real world problems.
- **Differential Equations** – This unit focuses on modeling real world problems in ways that can lead to solutions using both analytic as well as computational methods.
- **Parametric Equations and Polar Coordinates** – The final unit of this class explores curves defined by parametric equations, Bézier curves, areas and lengths in polar coordinates, conical sections, and practical problem solving using these concepts.

Books: *Calculus: Early Transcendentals, International Metric Edition*. Stewart, James. Eighth Edition, ISBN-13: 978-1305266728

Application Development

Classroom	Labs	Credits: 3
3	-	

This class provides a solid foundation for programming using Object Oriented Programming (OOP) methods and Java. This class adds programming vocabulary, concepts, tools, critical thinking skills, and professional ways of working and behaving to the foundations established in the program's first semester.

Performance Objectives: As a result of successfully completing this course, students will be able to:

- Implement small to medium-sized Java applications employing Test-Driven Development when given appropriate basic UML design documents.
- Design and implement small console-based I/O java applications and applications that read and write files.
- Design and implement small to medium-sized event-driven Java applications using JavaFX.
- Continue to grow an understanding of UML formalisms in the study of application design and in communication with other software professionals.
- Understand and implement basic encapsulation in order to enhance opportunity for reuse and to simplify code and make it easier to understand.
- Continue to produce Engineering Notebook entries for future reference and for documenting the creation of Intellectual Property.
- Continue to add compelling evidence to one's professional portfolio.

In this class, students work on the following projects:

Science and Engineering Calculator Project for critical space mission professionals – The project has each intern working in small groups to explore how to implement four individual solutions to the calculator project. The first calculator is an integer calculator. The second is a double calculator with square root added. The third enhances the calculator by means of the addition of error terms to measured values. (For example, how does one add and multiply values in the form of mmmm±eee.) The final enhancement is to improve the expression of the results so that meaningless digits beyond the point of significance (as defined by the error term) are not displayed.

Tool for implementing Finite State Machines (FSMs) to enhance Java Applications – This project uses tables to represent finite state machines, and makes it possible for these tables to drive the execution of the finite state machine as part of a Java application. These table driven machines can serve as recognizers as well as other tools making it easier to used FSMs as part of an application.

Excel spreadsheet data analysis – This project provides the knowledge and the practiced skill to

programmatically read data from an Excel spreadsheet, process and analyze it, produce results, and/or creates a new resulting spreadsheet.

In addition, students:

- Capture effort information about their project work in a spreadsheet **Effort Log.**
- Record information about their project work and experiments, capturing notes and other data and evidence about their work performed in an **Engineering Notebook**.
- Maintain their personal **Professional Portfolio**, which provides concrete evidence that shows what the student has actually done and can be used to convince employers that the students have the knowledge, skills, and capabilities they say they have.

Books: *Big Java Early Objects* by Horstman

Software Testing & Tools

Classroom	Labs	Credits: 3
3	-	

In this class students are immersed in two realistic testing simulations; one as a Software Developer, and the other as a Tester who is part of a System Test Team.

Performance Objectives: As a result of successfully completing this course, students will be able to:

- As a Software Developer:
  - Define and implement Unit Tests
  - Implement Test Suites
  - Use Test tools for executing Unit Tests
  - Use tools for Defect Management
  - Define and collect Unit Test Metrics
  - Generate Unit Test Reports
  - Define the Entry and Exit criteria for Unit Test
- As a System Tester:
  - Define the scope and strategy for the Application under Test
  - Identify the Test Approach and Techniques
  - Estimate the Test Effort
  - Create a Baseline Test Plan
  - Define and collect Test Metrics
  - Design Tests
  - Build Test Suites
  - Define the Entry and Exit criteria for all levels of Testing
  - Use Test tools for Test Management, execution and Defect Management
  - Generate Test Reports
  - Close the Test

In this class, students work on the following projects:

As a Software Developer. Students role-play as a developer on a small team for a software consulting company. Students are provided with the base-code of a software product, requirements for some new features, a product defect list, and product release criteria. Students will update the product code, unit test their updates using professional tools and processes and, when done, release the updated product code to the Test group for System Testing.

As a System Tester. Students role-play as part of a System Testing team. The team receives an

updated software product and release notes from the software developers, test the received product using professional tools and processes, and generate a test report to management describing the state of the product.

Give and Receive 360-degree feedback. Students follow a process where they learn how to give and receive feedback about each other's behavior and performance in the course in a positive and professional manner.

In addition, students:

- Capture effort information about their project work in a spreadsheet **Effort Log.**
- Record information about their project work and experiments, capturing notes and other data and evidence about their work performed in an **Engineering Notebook**.
- Maintain their personal **Professional Portfolio**, which provides concrete evidence that shows what the student has actually done and can be used to convince employers that the students have the knowledge, skills, and capabilities they say they have.

Books: None

Communications II

Classroom	Labs	Credits: 3
3	-	

This college level writing class expands and refines the objectives of Communications I. As with Communications I, this class simulates a real-world business environment in which the student writes compositions required by various business scenarios. The course introduces writing research-based analytical, evaluative, and persuasive/argumentative compositions using rhetorical and research strategies.

Performance Objectives: As a result of successfully completing this course, students will be able to:

- Recognize the rhetorical features of any composition piece.
- Analyze the rhetoric of any composition piece.
- Respond to authors of different types of composition by writing an essay in the appropriate tone with consideration of the audience.
- Make effective use of rhetorical techniques.
- Write unified, coherent and well-developed analytical/rhetorical essays
- Write a researched argument using at least 8 scholarly/peer reviewed sources, with the option of using some non-scholarly web sources as additional support.
- Use the library's public access catalog to locate books and articles, including use of the online article databases.
- Use MLA or APA documentation style appropriately per the assignment requirements.
- Read critically, outline, and summarize complex analytical essays/articles.
- Apply a well-formed process when completing writing assignments to facilitate quality results in a timely manner.
- Write grammatically correct sentences.

In addition, students:

- Capture effort information about their project work in a spreadsheet **Effort Log.**
- Record information about their project work and experiments, capturing notes and other data and evidence about their work performed in an **Engineering Notebook**.
- Maintain their personal **Professional Portfolio**, which provides concrete evidence that shows what the student has actually done and can be used to convince employers that the students have the knowledge, skills, and capabilities they say they have.

Books:

- None