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~~The Research and Curriculum Unit (RCU), located in Starkville, MS, as part of Mississippi State University, was established to foster educational enhancements and innovations. In keeping with the land grant mission of Mississippi State University, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances 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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~~Mr. Howell "Hal" N. Gage, Vice Chair~~
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~~Standards~~

~~Standards are superscripted in each unit and are referenced in the appendices. Standards in the Industrial Maintenance *Curriculum Framework and Supporting Materials* are based on the following:~~

~~NCCER Learning Series from the National Center for Construction Education and Research~~
~~Reprinted with permission from NCCER Learning Series, Copyright © 2008, National Center for Construction Education and Research, (352) 334-0920,~~
~~http://www.nccer.org/index.asp~~

~~Common Core State Standards Initiative~~
~~The Common Core State Standards provide a consistent, clear understanding of what students are expected to learn, so teachers and parents know what they need to do to help them. The standards are designed to be robust and relevant to the real world, reflecting the knowledge and skills that our young people need for success in college and careers. With American students fully prepared for the future, our communities will be best positioned to compete successfully in the global economy. Copyright 2010. National Governors Association Center for Best Practices and Council of Chief State School Officers. All rights reserved. States and territories of the United States as well as the District of Columbia that have adopted the Common Core State Standards in whole are exempt from this provision, and no attribution to the National Governors Association Center for Best Practices and Council of Chief State School Officers is required. Reprinted from~~ ~~http://www.corestandards.org/.~~

~~National Educational Technology Standards for Students~~
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~~21st Century Skills and Information and Communication Technologies Literacy Standards~~
~~In defining 21st century learning, the Partnership for 21st Century Skills has embraced five content and skill areas that represent the essential knowledge for the 21st century: global awareness; civic engagement; financial, economic, and business literacy; learning skills that encompass problem-solving, critical-thinking, and self-directional skills; and information and communication technology (ICT) literacy.~~

~~Preface~~

~~Secondary career and technical education programs in Mississippi face with many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing true 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.~~

~~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; Carl D. Perkins Vocational Education Act IV, 2007; and No Child Left Behind Act of 2001).~~

~~Mississippi Teacher Professional Resources~~

~~The following are resources for Mississippi teachers.~~

~~Curriculum, Assessment, Professional Learning, and other program resources can be found at The Research and Curriculum Unit's website: http://www.rcu.msstate.edu~~

~~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, please call 662.325.2510.~~

~~My PLC: An online registration for all professional-development sessions~~

~~To register for any session, teachers will need an account in the registration system, MyPLC, https://myplc.rcu.msstate.edu. To create an account, click on the link and navigate to the "Request a Guest ID" link. The ID should be the teacher's first initial and last name and the last four (4) digits of the social security number. Teachers should complete the entire form, which will then be sent to a secure server. Upon activation of the teacher's account, he or she will receive an e-mail with login instructions. The teacher may then browse for the available sessions and register for the desired courses.~~

~~Should you need additional instructions, please call 662.325.2510.~~

~~Executive Summary~~

~~Pathway Description~~

~~Industrial Maintenance is an instructional program that prepares students for employment or continued education in the occupations of installation, maintenance, and repair work. The curriculum framework for this program was developed in partnership with the Mississippi Construction Education Foundation (MCEF). MCEF is the accredited sponsor for the National Center for Construction Education and Research (NCCER).~~

~~When developing this curriculum, the authors recognized the importance of incorporating differentiated instruction and the needs of the 21st-century learners. Therefore, teaching strategies include a blend of online and face-to-face instruction that align with NCCER Connect e-books, online lectures, video presentations, online quizzes, active figures, and Spanish content. Students will have access to this information to learn new content as well as to review, reinforce, or revise their work.~~

~~Industry Certification~~

~~The NCCER developed and published a set of industry standards that are taught nationwide by contractors, associations, construction users, and secondary and postsecondary schools called the~~ **~~NCCER *Learning Series*.~~** ~~When developing this set of standards, the NCCER assembled a team of subject matter experts that represented construction companies and schools across the nation. Each committee met several times and combined experts' knowledge and experience to finalize the set of national industry standards.~~

~~As a part of the certification process, all Mississippi Manufacturing Technology instructors will be required to successfully complete the~~ **~~Instructor Certification Training Program~~**~~. This program ensures that instructors possess a deep knowledge of content of the standards.~~

~~This state-of-the-art curriculum is modeled after the eight Mississippi **NCCER Accredited Training and Education Facilities (ATEF)**. School districts must meet a set of guidelines to become an NCCER ATEF program including the following:~~

1. ~~Use the approved curriculum.~~
2. ~~All instructors must be NCCER certified.~~
3. ~~All completed Form 200s and release forms on all student completions are to be forwarded to MCEF for proper approval. MCEF will in turn forward to NCCER for processing.~~
4. ~~Follow NCCER guidelines on test security and performance profiles.~~
5. ~~Have an active advisory committee with at least two commercial contractors involved.~~
6. ~~Follow safety practices and Occupational Safety and Health Administration (OSHA) standards used in the class and lab areas.~~
7. ~~Involve commercial contractors in class presentations or field trips.~~
8. ~~All construction programs must be included in the accreditation process.~~
9. ~~Show active involvement in student leadership development (e.g., VICA and SkillsUSA).~~
10. ~~Provide demonstrated placement into construction-related occupations, and provide timely reports to MCEF.~~

~~Districts will be required to complete a self-evaluation of all programs and host a site visit from industry to ensure proper lab, safety, and instructional procedures are in place.~~

~~Assessment~~

~~The latest assessment blueprint for the curriculum can be found at~~

~~http://www.rcu.msstate.edu/Curriculum/CurriculumDownload.aspx~~

~~Student Prerequisites~~

~~In order for students to be able to experience success in the Industrial Maintenance program, the following student prerequisites are suggested:~~

1. ~~C or higher in English (the previous year)~~
2. ~~C or higher in Math (last course taken or the instructor can specify the math)~~
3. ~~Instructor Approval and TABE Reading Score (eighth grade or higher)~~

   ~~or~~

4. ~~TABE Reading Score (eighth grade or higher)~~

   ~~or~~

5. ~~Instructor Approval~~

~~Teacher Licensure~~

~~The latest teacher licensure information can be found at~~

~~http://www.mde.k12.ms.us/educator-licensure~~

~~Professional Learning~~

~~If you have specific questions about the content of any of training sessions provided, please contact the Research and Curriculum Unit at 662.325.2510 and ask for a professional-learning specialist.~~

~~Course Outlines~~

~~It is recommended that the courses should be taken in sequence.~~

- ~~Scheduling and operating more than one course in the same classroom/laboratory with the same teacher is not allowed.~~
- ~~Safety will be reinforced and tested at the beginning of each course.~~
- ~~Students must complete Installation and Service Core with a score of 80/C or higher in class work to advance to the next level.~~

~~Option 1—Four, One-Carnegie-Unit Courses~~

~~Upon completion of this option, the student will be prepared to take the~~ **~~Industrial Maintenance Level 1 certification~~** ~~exams. This curriculum consists of four one-credit courses, which should be completed in the following sequence:~~

1. **~~Fundamentals of Industrial Maintenance—Course Code: 993002~~**
2. **~~Application of Industrial Maintenance—Course Code: 993003~~**
3. **~~Theory of Industrial Maintenance—Course Code: 993012~~**
4. **~~Advanced Skills of Industrial Maintenance—Course Code: 993013~~**

~~Course Description: Fundamentals of Industrial Maintenance~~

~~Fundamentals of Industrial Maintenance includes an introduction to the field as well as fundamentals of safety, math, and hand and power tools.~~

~~**Course Description: Application of Industrial Maintenance**~~

~~Application of Industrial Maintenance provides an introduction to blueprints, materials handling, orientation to the trade, tools of the trade, fasteners and anchors, oxy-fuel cutting, introduction to National Electrical Code, and craft related mathematics. This course gives students real-world, hands-on practice in these areas.~~

~~**Course Description: Theory of Industrial Maintenance**~~

~~Theory of Industrial Maintenance includes an in-depth study of the industrial maintenance profession, test equipment, gaskets and packing, pumps and pump drivers, types of valves, and machine lubrication. This course also reinforces safety related to the industrial maintenance industry.~~

~~**Course Description: Advanced Skills of Industrial Maintenance**~~

~~Advanced Skills of Industrial Maintenance includes an in-depth study of material handling and rigging, and mobile and support equipment, electrical theory, conductor terminations and splices, and hydraulic and pneumatic controls.~~

~~**Fundamentals of Industrial Maintenance—Course Code: 993002**~~

~~**Unit**~~		~~**Title**~~	~~**Hours**~~
~~1~~		~~Introduction and Orientation~~	~~25~~
~~2~~		~~Basic Safety~~	~~25~~
~~3~~		~~Introduction to Construction Math~~	~~20~~
~~4~~		~~Hand and Power Tools~~	~~40~~
~~5~~		~~Introduction to Construction Drawings~~	~~30~~
			~~**140**~~

~~Application of Industrial Maintenance—Course Code: 993003~~

~~Unit~~		~~Title~~	~~Hours~~
~~6~~		~~Introduction to Materials Handling~~	~~25~~
~~7~~		~~Tools of the Trade, Fasteners and Anchors, and Oxy-Fuel Cutting~~	~~50~~
~~8~~		~~Introduction to the National Electrical Code~~	~~15~~
~~9~~		~~Basic Electrical~~	~~25~~
~~10~~		~~Copper and Plastic Piping, and Soldering and Brazing~~	~~25~~
			~~**140**~~

~~Theory of Industrial Maintenance—Course Code: 993012~~

~~Unit~~		~~Title~~	~~Hours~~
~~11~~		~~Safety Review and Orientation to the Trade~~	~~10~~
~~12~~		~~Craft Related Mathematics~~	~~15~~
~~13~~		~~Gaskets and Packing, Pumps and Drivers, Introduction to Valves, and Lubrication~~	~~65~~
~~14~~		~~Construction Drawings, Test Equipment, Material Handling and Rigging, and Mobile and Support Equipment~~	~~50~~
			~~**140**~~

~~Advanced Skills of Industrial Maintenance—Course Code: 993013~~

~~Unit~~		~~Title~~	~~Hours~~
~~15~~		~~Conduit Bending~~	~~10~~
~~16~~		~~Electrical Theory, Conductor Terminations and Splices, and Hydraulic and Pneumatic Controls~~	~~65~~
~~17~~		~~Shielded Metal Arc Welding~~	~~65~~
			~~**140**~~

~~**Option 2 – Two, Two-Carnegie-Unit Course**~~

~~Upon completion of this option, the student will be eligible to take the **NCCER Core Level 1 Certification** exam.~~

~~This curriculum consists of two, two-credit courses as follows:~~

1. ~~**Industrial Maintenance I – Course Code: 993001**~~
2. ~~**Industrial Maintenance II – Course Code: 993011**~~

~~**Course Description**: Industrial Maintenance I~~

~~The Industrial Maintenance I course introduces students to fundamentals of safety, tools, math, blueprint reading, materials handling, fasteners and anchors, oxy-fuel cutting, and an introduction to the National Electrical Code.~~

~~**Industrial Maintenance I – Course Code: 993001**~~

~~**Unit**~~		~~**Title**~~	~~**Hours**~~
~~1~~		~~Introduction and Orientation~~	~~25~~
~~2~~		~~Basic Safety~~	~~25~~
~~3~~		~~Introduction to Construction Math~~	~~20~~
~~4~~		~~Hand and Power Tools~~	~~40~~
~~5~~		~~Introduction to Construction Drawings~~	~~24~~
~~6~~		~~Introduction to Materials Handling~~	~~24~~
~~7~~		~~Tools of the Trade, Fasteners and Anchors, and Oxy-Fuel Cutting~~	~~46~~
~~8~~		~~Introduction to the National Electrical Code~~	~~8~~
~~9~~		~~Basic Electrical~~	~~13~~
~~10~~		~~Copper and Plastic Piping, and Soldering and Brazing~~	~~20~~
			~~**245**~~

~~**Course Description**: **Industrial Maintenance II**~~

~~Industrial Maintenance II is a continuation of Industrial Maintenance I with the emphasis on employability skills, safety, gaskets, packing, pumps, drivers, valves, lubrication, construction drawings, test equipment, material handling and rigging, mobile and support equipment,~~

~~electrical theory, conductor termination and splices, hydraulic and pneumatic controls, and welding.~~

~~Industrial Maintenance II – Course Code: 993011~~

~~Unit~~		~~Title~~	**~~Hours~~**
~~11~~		~~Safety Review and Orientation to the Trade~~	~~10~~
~~12~~		~~Craft Related Mathematics~~	~~15~~
~~13~~		~~Gaskets and Packing, Pumps and Drivers, Introduction to Valves, and Lubrication~~	~~65~~
~~14~~		~~Construction Drawings, Test Equipment, Material Handling and Rigging, and Mobile and Support Equipment~~	~~50~~
~~15~~		~~Conduit Bending~~	~~10~~
~~16~~		~~Electrical Theory, Conductor Terminations and Splices, and Hydraulic and Pneumatic Controls~~	~~65~~
~~17~~		~~Shielded Metal Arc Welding~~	~~65~~
			~~280~~

~~Research Synopsis~~

~~Introduction~~

~~By implementing the National Center for Construction Education and Research in the construction skills standards to the Maintenance, Installation & Repair Pathway, students who successfully master the curriculum should have the skills required to enter the workforce or pursue an advanced degree. These skills are based on industry-validated performance indicators. The pathway will include applied instruction designed to articulate with programs offered in Mississippi's community and junior colleges.~~

~~Needs of the Future Workforce~~

~~Occupations in the Industrial Maintenance fields are projected to have about as fast as average to faster than average growth in Mississippi between 2008 and 2018. The U.S. Bureau of Labor Statistics reports that job prospects will be excellent for technicians in this field, particularly those who have received training at accredited technical schools.~~

~~Table 1.1: Current and Projected Occupation Report for Installation and Service Technology~~
~~*Source*: Mississippi Department of Employment Security; www.mdes.ms.gov (accessed March 8, 2013).~~

~~**Description**~~	~~**Jobs, 2008**~~	~~**Projected Jobs, 2018**~~	~~**Change(Number)**~~	~~**Change (Percent)**~~	~~**Average Hourly Wage**~~
~~Helpers—Installation, Maintenance, and Repair Workers~~	~~1,850~~	~~2,100~~	~~250~~	~~13.5~~	~~$11.90~~
~~Installation, Maintenance, and Repair Workers, All Other~~	~~450~~	~~500~~	~~50~~	~~11.1~~	~~$21.03~~

~~Perkins IV Requirements~~

~~The Industrial Maintenance curriculum meets Perkins IV requirements of high-skill, high-wage, and/or high-demand occupations by introducing students to and preparing students for occupations. It also offers students a program of study including secondary, postsecondary, and IHL courses that will prepare them for occupations in these fields. Additionally, the Industrial Maintenance curriculum is integrated with academic common core standards. Lastly, the Industrial Maintenance curriculum focuses on ongoing and meaningful professional development for teachers as well as relationships with industry.~~

~~Curriculum Content~~

~~Summary of Standards~~

~~The standards to be included in the Industrial Maintenance curriculum are the Common Core Standards for Mathematics and Science, 21st Century Skills, and the National Educational Technology Standards (NETS) for Students. Combining these standards to create this document will result in highly skilled, well-rounded students who are prepared to enter a secondary academic or career and technical program of study. They will also be prepared to academically compete nationally as the Common Core Standards are designed to prep students for success in community colleges, Institutions of Higher Learning and careers.~~

~~Transition to Postsecondary Education~~

~~The latest articulation information for Secondary to Postsecondary can be found at the Mississippi Community College Board (MCCB) website~~ ~~http://www.mccb.edu/~~

~~Best Practices~~

~~Experiential Learning (SAE)~~

~~The Experiential Learning (SAE) has long been and continues to be the backbone of every industrial maintenance program. The experiential learning projects can be used in a variety of situations to reinforce and compliment classroom theory and content. The experiential learning project consists of entrepreneurship, placement, research/experimentation and exploratory.~~

~~Innovative Instructional Technologies~~

~~Recognizing that today's students are digital learners, the classroom should be equipped with tools that will teach them in the way they need to learn. The Industrial Maintenance teacher's goal should be to include teaching strategies that incorporate current technology. It is suggested that each classroom house a classroom set of desktop student computers and one~~

~~teacher laptop. To make use of the latest online communication tools such as wikis, blogs, and podcasts, the classroom teacher is encouraged to use a learning management system, for example, the Industrial Maintenance Teacher Learning Management System, that introduces students to education in an online environment and places the responsibility of learning on the student.~~

~~*Differentiated Instruction*~~

~~Students learn in a variety of ways. Some are visual learners, needing only to read information and study it to succeed. Others are auditory learners, thriving best when information is read aloud to them. Still others are tactile learners, needing to participate actively in their learning experiences. Add the student's background, emotional health, and circumstances, and a very unique learner emerges. Many activities are graded by rubrics that allow students to choose the type of product they will produce. By providing various teaching and assessment strategies, students with various learning styles can succeed.~~

~~*Career and Technical Education 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 Industrial Maintenance curriculum. SkillsUSA is the student's organization for Industrial Maintenance. SkillsUSA provides students with growth opportunities and competitive events. It also opens the doors to the world of agriculture and scholarships opportunities.~~

~~*Cooperative Learning*~~

~~Cooperative learning can help students understand topics when independent learning cannot. Therefore, you will see several opportunities in the Industrial Maintenance 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 Industrial Maintenance curriculum provides opportunities for students to work together and help each other to complete complex tasks.~~

~~Conclusions~~

~~The Industrial Maintenance curriculum is one of Mississippi's most comprehensive manufacturing curriculums. Students that complete these programs are well equipped for a variety of endeavors. Instructors are urged to encourage Industrial Maintenance students to pursue educational opportunities at community colleges and universities in Mississippi.~~

~~Professional Organizations~~

~~Association for Career and Technical Education (ACTE)~~
~~1410 King Street~~
~~Alexandria, VA 22314~~
~~800.826.9972~~
~~http://www.acteonline.org~~

~~SkillsUSA~~
~~14001 SkillsUSA Way~~
~~Leesburg, VA 20176~~
~~703.777.8810~~
~~FAX: 703.777.8999~~
~~http://www.skillsusa.org/~~

~~Using This Document~~

~~Suggested Time on Task~~

~~This section indicates an estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75–80% of the time in the course.~~

~~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.~~

~~Integrated Academic Topics, 21st Century Skills and Information and Communication Technology Literacy Standards, ACT College Readiness Standards, and Technology Standards for Students~~

~~This section identifies related academic topics as required in the Subject Area Testing Program (SATP) in Algebra I, Biology I, English II, and U.S. History from 1877, which are integrated into the content of the unit. Research-based teaching strategies also incorporate ACT College Readiness standards. This section also identifies the 21st Century Skills and Information and Communication Technology Literacy skills. In addition, national technology standards for students associated with the competencies and suggested objectives for the unit are also identified.~~

~~References~~

~~A list of suggested references is provided for each unit. The list includes some of the primary instructional resources that may be used to teach the competencies and suggested objectives. Again, these resources are suggested, and the list may be modified or enhanced based on needs and abilities of students and on available resources.~~

~~Unit 1: Introduction and Orientation~~

~~**Competencies and Suggested Objectives**~~
~~1. Describe local program and center expectations, policies, and procedures. DOK 1, EMP~~ ~~a. Describe local program and career center policies and procedures, including dress code, attendance, academic requirements, discipline, shop/lab rules and regulations, and transportation regulations.~~ ~~b. Give a brief overview of the course. Explain to students what Manufacturing Technology is, why it is important, and how it will be delivered.~~ ~~c. Compare and contrast local program and school policies to expectations of employers.~~ ~~d. Preview course objectives, program policy, and the industry standards.~~
~~2. Describe employment opportunities and responsibilities. DOK 1, EMP~~ ~~a. Describe employment opportunities, including potential earnings, employee benefits, job availability, working conditions, educational requirements, required technology skills, and continuing education/training.~~ ~~b. Describe basic employee responsibilities and appropriate work ethics.~~ ~~c. Compare and contrast employment responsibilities and expectations to local school and program policies and expectations.~~ ~~d. Demonstrate computer systems and their uses in the manufacturing industry.~~ ~~e. Define effective relationship skills and workplace issues to include but not limited to sexual harassment, stress, and substance abuse.~~
~~3. Research, design, and conduct a project that will apply the knowledge and skills learned in the Maintenance, Installation & Repair Pathway course in a real-world, unpredictable environment. DOK3, EMP~~ ~~a. Demonstrate effective team-building and leadership skills.~~ ~~b. Explore leadership skills and personal-development opportunities provided to students through student organizations such as SkillsUSA.~~ ~~c. Work as a team to design a community service project for which the knowledge and skills learned in the course can be used to improve the lives of others.~~
~~4. Demonstrate the ability to follow verbal and written instructions and communicate effectively in on-the-job situations. DOK 2, COM~~ ~~a. Follow basic written and verbal instructions.~~ ~~b. Effectively communicate in on-the-job situations using verbal, written, or electronic communication.~~

~~Unit 2: Basic Safety~~

~~**Competencies and Suggested Objectives**~~
~~1. Describe, define, and illustrate general safety rules for working in a shop/lab and how they relate to the manufacturing industry. DOK 2, BSM~~ ~~a. Describe how to avoid on-site accidents.~~ ~~b. Explain the relationship between housekeeping and safety.~~ ~~c. Explain the importance of following all safety rules and company safety policies according to OSHA standards, including addressing General Duty Clause and *1926 CFR Subpart C.*~~ ~~d. Explain the importance of reporting all on-the-job injuries, accidents, and near misses.~~ ~~e. Explain the need for evacuation policies and the importance of following them.~~ ~~f. Explain causes of accidents and the impact of accident costs.~~ ~~g. Compare and contrast shop/lab safety rules to industry safety rules.~~ ~~**Note:** Safety is to be taught as an ongoing part of the program. Students are required to complete the 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.~~
~~2. Identify and apply safety around welding operations. DOK 1, BSM~~ ~~a. Use proper safety practices when welding or working around welding operations.~~ ~~b. Use proper safety practices when welding in or near trenches and excavations.~~ ~~c. Explain the term "proximity work."~~
~~3. Display appropriate safety precautions to take around common jobsite hazards. DOK 1, BSM~~ ~~a. Explain the safety requirements for working in confined areas.~~ ~~b. Explain the different barriers and barricades and how they are used.~~
~~4. Demonstrate the appropriate use and care of personal protective equipment (PPE). DOK 1, BSM~~ ~~a. Identify commonly used PPE items.~~ ~~b. Understand proper use of PPE.~~ ~~c. Demonstrate appropriate care for PPE.~~
~~5. Explain fall protection, ladder, stair, and scaffold procedures and requirements. DOK 1, BSM~~ ~~a. Explain the use of proper fall protection.~~ ~~b. Inspect and safely work with various ladders, stairs, and scaffolds.~~
~~6. Explain the material safety data sheet (MSDS). DOK 1, BSM~~ ~~a. Explain the function of the MSDS.~~ ~~b. Interpret the requirements of the MSDS.~~ ~~c. Discuss hazardous material exposures.~~
~~7. Display appropriate safety procedures related to fires. DOK 1, BSM~~ ~~a. Explain the process by which fires start.~~ ~~b. Explain fire prevention of various flammable liquids.~~ ~~c. Explain the classes of fire and the types of extinguishers.~~ ~~d. Illustrate the proper steps to follow when using a fire extinguisher.~~ ~~e. Demonstrate the proper techniques for putting out a fire.~~
~~8. Explain safety in and around electrical situations. DOK 1, BSM~~ ~~a. Explain injuries that can result when electrical contact occurs.~~

~~b. Explain safety around electrical hazards.~~
~~c. Explain action to take when an electrical shock occurs.~~

~~Unit 3: Introduction to Construction Math~~

~~**Competencies and Suggested Objectives**~~
~~1. Apply the four basic math skills using whole numbers, fractions, decimals, and percentages, both with and without a calculator.~~ ~~DOK 2, ICM~~ ~~a. Define basic geometric shapes used in the manufacturing industry.~~ ~~b. Add, subtract, multiply, and divide whole numbers, decimals, and fractions with and without a calculator.~~ ~~c. Convert whole numbers to fractions, and convert fractions to whole numbers.~~ ~~d. Convert decimals to percentages, and convert percentages to decimals.~~ ~~e. Convert fractions to decimals.~~ ~~f. Convert fractions to percentages.~~ ~~g. Demonstrate reading a standard and metric ruler and tape measure.~~ ~~h. Recognize and use metric units of length, weight, volume, and temperature.~~

~~Unit 4: Hand and Power Tools~~

~~**Competencies and Suggested Objectives**~~
~~1. Demonstrate the use and maintenance of hand and power tools.~~ ~~DOK 2, IHT, IPT~~ ~~a. Identify, visually inspect, and discuss the safe use of common hand and power tools.~~ ~~b. Discuss rules of safety.~~ ~~c. Select and demonstrate the use of tools.~~ ~~d. Explain the procedures for maintenance.~~

~~Unit 5: Introduction to Construction Drawings~~

~~**Competencies and Suggested Objectives**~~
~~1. Read, analyze, and understand basic components of a blueprint.~~ ~~DOK 3, BLU~~ ~~a. Recognize and identify terms, components, and symbols commonly used on blueprints.~~ ~~b. Relate information on construction drawings to actual locations on the print.~~ ~~c. Recognize different classifications of drawing.~~ ~~d. Interpret and use drawing dimensions.~~

~~Unit 6: Introduction to Materials Handling~~

~~**Competencies and Suggested Objectives**~~
~~1. Safely handle and store materials.~~ ~~DOK 2, IMH~~ ~~a. Define a load.~~ ~~b. Establish a pre-task plan prior to moving a load.~~ ~~c. Use proper materials-handling techniques.~~ ~~d. Choose appropriate materials-handling equipment for the task.~~ ~~e. Recognize hazards and follow safety procedures required for materials handling.~~

~~Unit 7:Tools of the Trade, Fasteners and Anchors, and Oxy-Fuel Cutting~~

~~**Competencies and Suggested Scenarios**~~
~~1. Identify and use tools found in the Industrial Maintenance trade, describe how each is used, and discuss proper care and maintenance of the tools.~~ ~~DOK2, TTI~~ ~~a. Illustrate the use of tools used in the Industrial Maintenance profession.~~ ~~b. Identify and use common hand and power tools used in the Industrial Maintenance trade.~~
~~2. Identify various fasteners and anchors found in the Industrial Maintenance trade, how to install and remove fasteners and anchors, and how to select the correct fastener or anchor for an application~~ ~~DOK2, FAN~~ ~~a. Identify and install threaded fasteners, non-threaded fasteners, and anchors.~~ ~~b. Identify various grades of bolt hardness.~~
~~3. Identify and describe the basic equipment, setup, and safety rules for proper use of oxy-fuel equipment.~~ ~~DOK2, OXC~~ ~~a. Identify and explain the use of oxy-fuel equipment.~~ ~~b. Demonstrate how to use an oxy-fuel torch.~~ ~~c. Perform oxy-fuel cutting:~~ ~~• Straight line and square shapes~~ ~~• Piercing and slot cutting~~ ~~• Bevels~~ ~~• Washing~~

~~Unit 8: Introduction to the National Electrical Code~~

~~**Competencies and Suggested Objectives**~~
~~1. Describe the purpose of the NEC, reference NEC code, and explain current applications of the NEC.~~ ~~DOK2, NEC~~ ~~a. Explain the purpose and history of the National Electrical Code (NEC).~~ ~~b. Use the NEC to reference industrial applications.~~ ~~c. Explain the role of nationally recognized testing laboratories.~~

~~Unit 9: Basic Electrical~~

~~**Competencies and Suggested Objectives**~~
~~1. Identify electrical safety hazards, demonstrate safety around circuits and equipment, describe basic electricity laws, interpret electrical drawings and schematics, and demonstrate wiring basic electrical circuits.~~ ~~DOK2, BEL~~ ~~a. Describe how voltage, current, resistance, and power are mathematically related.~~ ~~b. Describe the difference between series and parallel circuits, and calculate loads in each.~~ ~~c. Describe the purpose and operation of the various electrical components used in equipment.~~

~~Unit 10: Copper and Plastic Piping, and Soldering and Brazing~~

~~**Competencies and Suggested Scenarios**~~
~~1. Demonstrate the safe use and routine maintenance of hand and power tools used in the Industrial Maintenance trade.~~ ~~DOK2, IHT, IPT~~ ~~a. Demonstrate the safe use and maintenance of hand and power tools used in Industrial Maintenance.~~
~~2. Identify and discuss the tools used in the piping trade, discuss the materials and methods of connecting piping systems, and perform copper and plastic piping tasks found in the industrial maintenance and Industrial Maintenance environment.~~ ~~DOK2, CPP~~ ~~a. Discuss and demonstrate how to use copper tubing in Industrial Maintenance.~~ ~~b. Discuss and demonstrate how to use plastic tubing in Industrial Maintenance.~~
~~3. Prepare and solder copper piping systems in various industrial and Industrial Maintenance applications and properly clean, install fittings, and braze piping (silver solder~~ ~~DOK2, SBR~~ ~~a. Solder copper pipe in Industrial Maintenance.~~ ~~b. Braze copper pipe in Industrial Maintenance.~~

~~Unit 11: Safety Review and Orientation to the Trade~~

~~Review and Reinforcement~~

~~**Competencies and Suggested Objectives**~~
~~1. Describe local program and vocational/career technical center policies and procedures. DOK2~~ ~~a. Describe local program and vocational/career technical center policies and procedures.~~
~~2. Explore leadership skills and personal development opportunities provided for students by student organizations to include SkillsUSA. DOK2~~ ~~a. Demonstrate effective team-building and leadership skills.~~ ~~b. Demonstrate through practice appropriate work ethics.~~
~~3. Orientation to the Trade DOK2, OTT, EMP~~ ~~a. Describe the types of work performed by industrial maintenance craftworkers.~~ ~~b. Identify career opportunities available to industrial maintenance craftworkers.~~ ~~c. Explain the purpose and objectives of an apprentice training program.~~ ~~d. Explain the responsibilities and characteristics of a good industrial maintenance craftworker.~~ ~~e. Explain the importance of safety in relation to industrial maintenance craftworkers.~~ ~~f. Explain the role of NCCER in the training process.~~

~~Unit 12: Craft Related Mathematics~~

~~**Competencies and Suggested Objectives**~~
~~1. Identify and explain measuring devices, solve geometric mathematical problems, and use weights and measurement standards.~~ ~~DOK2, CRM~~ ~~a. Discuss mathematics used in the installation and services industry.~~

~~Unit 13: Gaskets and Packing, Pumps and Drivers, Introduction to Valves, and Lubrication~~

~~**Competencies and Suggested Objectives**~~
~~1. Identify different types of gasket and packing materials, list their applications, and install gaskets and packing. DOK2, GAP~~ ~~a. Identify the various types and materials of gaskets.~~ ~~b. Describe the use of O-rings in the installation and service trade.~~ ~~c. Describe the uses and methods of packing in the installation and service trade.~~
~~2. Identify types of pumps and prime movers, and explain pressure differential between inlet and outlet of pumps. DOK2, PAD~~ ~~a. Identify and explain centrifugal, rotary, reciprocating, metering, and vacuum pumps.~~ ~~b. Explain net positive suction head and cavitation.~~ ~~c. Identify types of drivers.~~
~~3. Identify types of valves, and explain how to store and properly install valves. DOK2, ITV~~ ~~a. Identify types of valves that start, stop, regulate, relieve pressure, and regulate direction of flow.~~ ~~b. Explain how to properly store, handle, and mount valves in various locations and positions.~~
~~4. Describe and explain lubricant classification, additives, uses, and environments regulation regarding disposal of oils and greases. DOK2, LUB~~ ~~a. Explain regulatory law regarding industrial lubricants.~~ ~~b. Explain how lubricants protect mechanical machinery.~~ ~~c. Explain the properties and handling of lubricants and grease.~~

~~Unit 14: Construction Drawings, Test Equipment, Material Handling and Rigging, Mobile and Support Equipment~~

~~**Competencies and Suggested Objectives**~~
~~1. Identify and explain measuring devices, solve geometric mathematical problems, and use weights and measurement standards. DOK2, CRM~~ ~~a. Discuss mathematics used in the installation and services industry.~~
~~2. Identify components of the blueprint and scales, and perform projects from blueprints. DOK2, CDI~~ ~~a. Read and draw a basic blueprint found in the installation and service area.~~
~~3. Identify and explain the use of various test equipment used in the trade, differentiate between analog and digital meter readouts, and properly test circuits and mechanisms using available school metering devices. DOK2, ITE~~ ~~a. Explain the operation of the following pieces of test equipment:~~ ~~• Tachometer~~ ~~• Pyrometers~~ ~~• Multimeters~~ ~~• Automated diagnostics tools~~ ~~• Wiggy voltage tester~~ ~~• Stroboscope~~ ~~• Frequency meter~~ ~~b. Explain how to read and convert from one scale to another using the above test equipment.~~
~~4. Identify and explain safe rigging practices, load distribution, hand signals, and rigging equipment. DOK2, MHR~~ ~~a. Identify, describe the uses of, inspect, and maintain common rigging hardware and equipment, including the following:~~ ~~• Jacks~~ ~~• Block and tackle~~ ~~• Chain hoists~~ ~~• Come-alongs~~ ~~b. Tie knots used in rigging.~~ ~~c. Identify basic rigging and crane safety procedures, and use the correct hand signals to guide a crane operator.~~
~~5. Recognize types of mobile and support equipment found in the trade, explain the application for each device, and safely use equipment. DOK2, MSE~~ ~~a. State and explain the safety precautions, operation, and application associated with the use of motor-driven equipment commonly used in industrial plants, such as the following:~~ ~~• Portable generators~~ ~~• Air compressors~~

- ~~Aerial lifts~~
- ~~Forklifts~~
- ~~Mobile cranes~~

~~b. Operate and perform preventive maintenance on the following equipment:~~

- ~~Portable generators~~
- ~~Air compressors~~
- ~~Aerial lifts~~

~~Unit 15: Conduit Bending~~

~~**Competencies and Suggested Objectives**~~
~~1. Identify types of conduit and sizes, bend various radiuses, and properly install conduit according to National Electrical Code.~~ ~~DOK2, HBE~~ ~~a. Identify the methods for hand bending and installing conduit.~~

~~Unit 16: Electrical Theory, Conductor Terminations and Splices, Hydraulic & Pneumatic Controls~~

~~**Competencies and Suggested Objectives**~~
~~1. Describe the units of measure of electricity and the types of circuits, define Ohm's and Kirchhoff's laws, and troubleshoot a simple circuit.~~ ~~DOK2, ETO, ALT~~ ~~a. Discuss the properties and physical laws of electricity.~~ ~~b. Identify the meters used to measure voltage, current, and resistance.~~ ~~c. Discuss the properties of a series and parallel circuit.~~ ~~d. Discuss the properties of alternating current.~~
~~2. Identify and make connections using various types of conductors, types of fastening devices, and NEC requirements for terminations and splices.~~ ~~DOK2, CON~~ ~~a. Describe how to make a conductor termination.~~ ~~b. Prepare cable ends for terminations and splices, and connect the ends using lugs or connectors.~~ ~~c. Train cable at termination points.~~ ~~d. Describe the National Electrical Code requirements for making cable terminations and splices.~~
~~3. Explain the principles of hydraulic and pneumatic systems.~~ ~~DOK2, HDC, PNC~~ ~~a. Discuss the principles of industrial hydraulics.~~ ~~b. Discuss the principles of industrial pneumatics.~~

~~Unit 17: Shielded Metal Arc Welding (SMAW)~~

~~**Competencies and Suggested Scenarios**~~
~~1. Perform basic SMAW welding operations.~~ ~~DOK2, WES, BMP, SMA~~ ~~a. Practice safety procedures for SMAW welding operations.~~ ~~b. Prepare base metal for SMAW welding.~~ ~~c. Demonstrate basic elements and techniques used in SMAW welding.~~ ~~Fabricate welding project to specifications.~~

~~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 Safety (Review and Reinforcement)~~		
	~~1.~~	~~Describe local program and vocational/career technical center policies and procedures.~~
	~~2.~~	~~Describe employment opportunities and responsibilities of the industrial mechanic.~~
	~~3.~~	~~Explore leadership skills and personal development opportunities provided for students by student organizations to include SkillsUSA.~~
	~~4.~~	~~Describe general safety rules for working in a shop/lab and industry.~~
	~~5.~~	~~Review and Reinforce the year one content.~~
~~Unit 2: Gaskets and Packing, Pumps and Drivers, Introduction to Valves, Lubrication, and Welding~~		
	~~1.~~	~~Identify different types of gasket and packing materials, list their applications, and install gaskets and packing.~~
	~~2.~~	~~Identify types of pumps and prime movers, and explain pressure differential between inlet and outlet of pumps.~~
	~~3.~~	~~Identify types of valves, and explain how to store and properly install valves.~~
	~~4.~~	~~Describe and explain lubricant classification, additives, uses, and environments regulation regarding disposal of oils and greases.~~
	~~5.~~	~~Perform basic SMAW welding operations.~~
~~Unit 3: Related Construction Math, Construction Drawings, Introduction to Test Equipment, Material Handling and Rigging, Mobile and Support Equipment~~		
	~~1.~~	~~Identify and explain measuring devices, solve geometric mathematical problems, and use weights and measurement standards.~~
	~~2.~~	~~Identify components of the blueprint and scales, and perform projects from blueprints.~~
	~~3.~~	~~Identify and explain the use of various test equipment used in the trade, differentiate between analog and digital meter readouts, and properly test circuits and mechanisms using available school metering devices.~~
	~~4.~~	~~Identify and explain safe rigging practices, load distribution, hand signals, and rigging equipment.~~
	~~5.~~	~~Recognize types of mobile and support equipment found in the trade, explain the application for each device, and safely use equipment.~~

	~~6.~~	~~Identify types of conduit and sizes, bend various radiuses, and properly install conduit according to National Electrical Code.~~
~~Unit 4: Introduction to the National Electrical Code, Electrical Theory, Conductor Terminations and Splices, Hydraulic & Pneumatic Controls~~		
	~~1.~~	~~Describe the purpose of the NEC, reference NEC code, and explain current applications of the NEC.~~
	~~2.~~	~~Describe the units of measure of electricity and the types of circuits, define Ohm's and Kirchhoff's laws, and troubleshoot a simple circuit.~~
	~~3.~~	~~Identify and make connections using various types of conductors, types of fastening devices, and NEC requirements for terminations and splices.~~
	~~4.~~	~~Explain the principles of hydraulic and pneumatic systems.~~

~~Appendix A: Unit References~~

~~General Books and Trade Publications~~
~~All of the Construction Core references listed under General Books and Trade Publications are used for multiple units. Unit-specific references are listed under the appropriate unit number.~~

~~Choices [Computer software]. (n.d.). Ogdensburg, NY: Careerware, IMS Information Systems Management.~~

~~Davies, D. (1997). *Grammar? No problem!* Mission, KS: SkillPath.~~

~~Gould, M. C. (2002). *Developing literacy and workplace skills*. Bloomington, IN: National Education Service. Local District Policy Handbook.~~

~~National Center for Construction Education and Research. (2009). *Core curriculum*. Upper Saddle River, NJ: Pearson Prentice Hall.~~

~~National Center for Construction Education and Research. (2007). *Industrial maintenance level I*. Upper Saddle River, NJ: Pearson Prentice Hall.~~

~~National Center for Construction Education and Research. (2007). *Industrial maintenance level II*. Upper Saddle River, NJ: Pearson Prentice Hall.~~
~~National Center for Construction Education and Research. (2009). *Tools for success*. Upper Saddle River, NJ: Pearson Prentice Hall.~~

~~SkillsUSA. (2002). *Leadership and competition curricula*. Tinley Park, IL: Goodheart-Willcox.~~

~~**Unit 1**~~

~~Green, D., & Gosse, J. (2000). *Industrial maintenance*. Homewood, IL: American Technical.~~

~~Kibbe, R. (2002). *Mechanical systems for industrial maintenance*. Upper Saddle River, NJ: Pearson Prentice Hall.~~

~~**Unit 2**~~

~~American Association for Vocational Instructional Materials. (2002). *Developing safety skills for shop or home*. Winterville, GA: Author.~~

~~Bevelacqua, A., & Stilp, R. (2007). *Hazardous materials field guide*. Albany, NY: Delmar.~~

~~The Construction Safety Council. (n.d.). Retrieved August 30, 2012, from http://www.buildsafe.org/~~

~~Earth Communications. (2004). *Safety on the job part 1: Standards of personal protection and health care* [Videotape]. (Available from Earth Communications, 2370 Proffit Rd., Charlottesville, VA 22911)~~

~~Earth Communications. (2004). *Safety on the job part 2: Fire protection, warnings and power tools* [Videotape]. (Available from Earth Communications, 2370 Proffit Rd., Charlottesville, VA 22911)~~

~~Goetsch, D. (2000). *The safety and health handbook*. Upper Saddle River, NJ: Pearson Prentice Hall.~~

~~**Unit 3**~~

~~Barrows, R., & Jones, B. (2002). *Fundamentals of math with career applications*. Upper Saddle River, NJ: Pearson Prentice Hall.~~

~~Boyce, J., Margolis, L., & Slade, S. (2000). *Mathematics for technical and vocational students*. Upper Saddle River, NJ: Prentice Hall.~~

~~Carman, R., & Saunders, H. (2011). *Mathematics for the trades: A guided approach*. Upper Saddle River, NJ: Pearson Prentice Hall.~~

~~Cook, N. (2004). *Introductory mathematics*. Upper Saddle River, NJ: Pearson Prentice Hall.~~

~~Cook, N. (2004). *Mathematics for technical trades*. Upper Saddle River, NJ: Pearson Prentice Hall.~~

~~**Unit 10**~~

~~American Association for Vocational Instructional Materials. (2002). *Developing safety skills for shop or home*. Winterville, GA: Author.~~

~~Bevelacqua, A., & Stilp, R. (2007). *Hazardous materials field guide*. Albany, NY: Delmar.~~

~~The Construction Safety Council. (n.d.). Retrieved August 30, 2012, from http://www.buildsafe.org/~~

~~Earth Communications. (2004). *Safety on the job part 1: Standards of personal protection and health care* [Videotape]. (Available from Earth Communications, 2370 Proffit Rd., Charlottesville, VA 22911)~~

~~Earth Communications. (2004). *Safety on the job part 2: Fire protection, warnings and power tools* [Videotape]. (Available from Earth Communications, 2370 Proffit Rd., Charlottesville, VA 22911)~~

~~Goetsch, D. (2000). *The safety and health handbook*. Upper Saddle River, NJ: Pearson Prentice Hall.~~

~~Appendix B: Industry Standards~~

~~INDUSTRIAL SERVICES PATHWAY~~
~~CONTENT STANDARDS AND PERFORMANCE ELEMENTS~~[1]

~~Crosswalk for Industrial Maintenance (Units 1-8)~~									
	~~Units~~	~~Unit 1~~	~~Unit 2~~	~~Unit 3~~	~~Unit 4~~	~~Unit 5~~	~~Unit 6~~	~~Unit 7~~	~~Unit 8~~
~~OTT - MODULE 40101-07 – ORIENTATION TO THE TRADE~~		~~X~~							
~~GAP - MODULE 40105-07 – GASKETS AND PACKING~~			~~X~~						
~~CRM - MODULE 40106-07 – CRAFT-RELATED MATHEMATICS~~				~~X~~			~~X~~		~~X~~
~~CDI - MODULE 40107-07 – CONSTRUCTION DRAWINGS~~				~~X~~		~~X~~			
~~PAD - MODULE 40108-07 – PUMPS AND DRIVERS~~			~~X~~						
~~ITV - MODULE 40109-07 – INTRODUCTIONTO VALVES~~			~~X~~						
~~ITE - MODULE 40110-07 – INTRODUCTIONTOTEST EQUIPMENT~~				~~X~~			~~X~~		
~~MHR - MODULE 40111-07 – MATERIAL HANDLING AND HAND RIGGING~~				~~X~~			~~X~~	~~X~~	
~~MSE - MODULE 40112-07 – MOBILE AND SUPPORT EQUIPMENT~~				~~X~~			~~X~~	~~X~~	
~~LUB - MODULE 40113-07 – LUBRICATION~~			~~X~~						
~~IME & INSTRUMENTATION TECHNICIAN LEVEL 2~~									
~~WEL – MODULE 29101-09, MODULE 29105-09, MODULE 29109-09,~~			~~X~~					~~X~~	
~~NEC – MODULE 40202-08 Introduction to the National Electrical Code~~					~~X~~	~~X~~		~~X~~	~~X~~
~~ETO – MODULE 40203-08 Electrical Theory~~					~~X~~			~~X~~	~~X~~
~~ALT – MODULE 40204-08 Alternating Current~~					~~X~~			~~X~~	~~X~~
~~HBE – MODULE 40208-08 Hand Bending~~				~~X~~				~~X~~	
~~CON – MODULE 40213-08 Conductor Terminations and Splices~~					~~X~~			~~X~~	
~~HDC – MODULE 40311-09 Hydraulic Controls~~					~~X~~				
~~PNC – MODULE 40312-09 Pneumatic Controls~~					~~X~~			~~X~~	

[1] *NCCER learning series.* Retrieved April 22, 2013, from http://www.nccer.org/

	~~Crosswalk for Industrial Maintenance (Units 9-17)~~									
	~~Units~~	~~Unit 9~~	~~Unit 10~~	~~Unit 10~~	~~Unit 12~~	~~Unit 13~~	~~Unit 14~~	~~Unit 15~~	~~Unit 16~~	~~Unit 17~~
~~OTT - MODULE 40101-07 – ORIENTATION TO THE TRADE~~				~~X~~						
~~GAP - MODULE 40105-07 – GASKETS AND PACKING~~						~~X~~				
~~CRM - MODULE 40106-07 – CRAFT-RELATED MATHEMATICS~~		~~X~~	~~X~~		~~X~~	~~X~~	~~X~~		~~X~~	
~~CDI - MODULE 40107-07 – CONSTRUCTION DRAWINGS~~			~~X~~				~~X~~			
~~PAD - MODULE 40108-07 – PUMPS AND DRIVERS~~						~~X~~				
~~ITV - MODULE 40109-07 – INTRODUCTIONTO VALVES~~						~~X~~				
~~ITE - MODULE 40110-07 – INTRODUCTIONTOTEST EQUIPMENT~~							~~X~~			
~~MHR - MODULE 40111-07 – MATERIAL HANDLING AND HAND RIGGING~~				~~X~~		~~X~~	~~X~~			
~~MSE - MODULE 40112-07 – MOBILE AND SUPPORT EQUIPMENT~~			~~X~~	~~X~~		~~X~~	~~X~~			
~~LUB - MODULE 40113-07 – LUBRICATION~~						~~X~~	~~X~~			
~~**IME & INSTRUMENTATION TECHNICIAN LEVEL 2**~~										
~~WEL – MODULE 29101-09, MODULE 29105-09, MODULE 29109-09,~~			~~X~~							~~X~~
~~NEC – MODULE 40202-08 Introduction to the National Electrical Code~~		~~X~~	~~X~~		~~X~~					
~~ETO – MODULE 40203-08 Electrical Theory~~		~~X~~	~~X~~		~~X~~				~~X~~	
~~ALT – MODULE 40204-08 Alternating Current~~		~~X~~							~~X~~	
~~HBE – MODULE 40208-08 Hand Bending~~			~~X~~				~~X~~	~~X~~		
~~CON – MODULE 40213-08 Conductor Terminations and Splices~~									~~X~~	
~~HDC – MODULE 40311-09 Hydraulic Controls~~							~~X~~		~~X~~	
~~PNC – MODULE 40312-09 Pneumatic Controls~~			~~X~~						~~X~~	

~~**NCCER CORE**~~

~~**BAS – 00101-09 – Introduction to Basic Safety**~~
~~**EMP – 00108-09 – Basic Employability Skills**~~

~~**IM E&I Technician Level 1**~~

~~**OTT - MODULE 40101-07 – ORIENTATION TO THE TRADE**~~
~~**GAP - MODULE 40105-07 – GASKETS AND PACKING**~~
~~**CRM - MODULE 40106-07 – CRAFT-RELATED MATHEMATICS**~~
~~**CDI - MODULE 40107-07 – CONSTRUCTION DRAWINGS**~~
~~**PAD - MODULE 40108-07 – PUMPS AND DRIVERS**~~
~~**ITV - MODULE 40109-07 – INTRODUCTIONTO VALVES**~~
~~**ITE - MODULE 40110-07 – INTRODUCTIONTOTEST EQUIPMENT**~~
~~**MHR - MODULE 40111-07 – MATERIAL HANDLING AND HAND RIGGING**~~
~~**MSE - MODULE 40112-07 – MOBILE AND SUPPORT EQUIPMENT**~~
~~**LUB - MODULE 40113-07 – LUBRICATION**~~

~~**Industrial Maintenance E&I Technician Level 2**~~

~~**NEC – MODULE 40202-08 Introduction to the National Electrical Code**~~
~~**ETO – MODULE 40203-08 Electrical Theory**~~
~~**ALT – MODULE 40204-08 Alternating Current**~~
~~**HBE – MODULE 40208-08 Hand Bending**~~
~~**CON – MODULE 40213-08 Conductor Terminations and Splices**~~

~~**Industrial Maintenance E&I Technician Level 3**~~

~~**HDC – MODULE 40311-09 Hydraulic Controls**~~
~~**PNC – MODULE 40312-09 Pneumatic Controls**~~

~~**Welding Level 1**~~

~~**WES – MODULE 29101-09 Welding Safety**~~
~~**BMP - MODULE 29105-09 Base Metal Preparation**~~
~~**SMA - MODULE 29109-09 SMAW Beads and Fillet Welds**~~

~~Appendix C: 21st Century Skills~~[2]

	~~Units~~	~~Unit 1~~	~~Unit 2~~	~~Unit 3~~	~~Unit 4~~	~~Unit 5~~	~~Unit 6~~	~~Unit 7~~	~~Unit 8~~
~~21st Century Standards~~									
~~CS1~~		~~X~~				~~X~~	~~X~~	~~X~~	~~X~~
~~CS2~~		~~X~~	~~X~~			~~X~~		~~X~~	
~~CS3~~		~~X~~				~~X~~	~~X~~		
~~CS4~~		~~X~~	~~X~~	~~X~~	~~X~~			~~X~~	~~X~~
~~CS5~~		~~X~~	~~X~~	~~X~~	~~X~~			~~X~~	~~X~~
~~CS6~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
~~CS7~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
~~CS8~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
~~CS9~~		~~X~~		~~X~~		~~X~~			
~~CS10~~		~~X~~		~~X~~					
~~CS11~~		~~X~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
~~CS12~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
~~CS13~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
~~CS14~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
~~CS15~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
~~CS16~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~

~~-~~

	~~Units~~	~~Unit 9~~	~~Unit 10~~	~~Unit 11~~	~~Unit 12~~	~~Unit 13~~	~~Unit 14~~	~~Unit 15~~	~~Unit 16~~	~~Unit 17~~
~~21st Century Standards~~										
~~CS1~~		~~X~~	~~X~~	~~X~~	~~X~~					
~~CS2~~				~~X~~	~~X~~	~~X~~				~~X~~
~~CS3~~				~~X~~	~~X~~					
~~CS4~~		~~X~~	~~X~~	~~X~~		~~X~~	~~X~~		~~X~~	~~X~~
~~CS5~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		~~X~~	~~X~~
~~CS6~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
~~CS7~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
~~CS8~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
~~CS9~~				~~X~~	~~X~~		~~X~~			
~~CS10~~				~~X~~	~~X~~		~~X~~			
~~CS11~~		~~X~~	~~X~~	~~X~~	~~X~~		~~X~~		~~X~~	
~~CS12~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		~~X~~	~~X~~
~~CS13~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		~~X~~	~~X~~
~~CS14~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		~~X~~	~~X~~
~~CS15~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		~~X~~	~~X~~
~~CS16~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		~~X~~	~~X~~

~~CSS1-21st Century Themes~~

- ~~**CS1 Global Awareness**~~
  1. ~~Using 21st century skills to understand and address global issues~~
  2. ~~Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts~~
  3. ~~Understanding other nations and cultures, including the use of non-English languages~~
- ~~**CS2 Financial, Economic, Business, and Entrepreneurial Literacy**~~
  1. ~~Knowing how to make appropriate personal economic choices~~
  2. ~~Understanding the role of the economy in society~~

[2] *21st century skills.* (n.d.). Washington, DC: Partnership for 21st Century Skills.

3. ~~Using entrepreneurial skills to enhance workplace productivity and career options~~

~~**CS3 Civic Literacy**~~

1. ~~Participating effectively in civic life through knowing how to stay informed and understanding governmental processes~~
2. ~~Exercising the rights and obligations of citizenship at local, state, national, and global levels~~
3. ~~Understanding the local and global implications of civic decisions~~

~~**CS4 Health Literacy**~~

1. ~~Obtaining, interpreting, and understanding basic health information and services and using such information and services in ways that enhance health~~
2. ~~Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance, and stress reduction~~
3. ~~Using available information to make appropriate health-related decisions~~
4. ~~Establishing and monitoring personal and family health goals~~
5. ~~Understanding national and international public health and safety issues~~

~~**CS5 Environmental Literacy**~~

1. ~~Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water, and ecosystems.~~
2. ~~Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.).~~
3. ~~Investigate and analyze environmental issues, and make accurate conclusions about effective solutions.~~
4. ~~Take individual and collective action toward addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues).~~

~~CSS2-Learning and Innovation Skills~~

~~**CS6 Creativity and Innovation**~~

1. ~~Think Creatively~~
2. ~~Work Creatively with Others~~
3. ~~Implement Innovations~~

~~**CS7 Critical Thinking and Problem Solving**~~

1. ~~Reason Effectively~~
2. ~~Use Systems Thinking~~
3. ~~Make Judgments and Decisions~~
4. ~~Solve Problems~~

~~**CS8 Communication and Collaboration**~~

1. ~~Communicate Clearly~~
2. ~~Collaborate with Others~~

~~CSS3-Information, Media and Technology Skills~~

~~**CS9 Information Literacy**~~

1. ~~Access and Evaluate Information~~
2. ~~Use and Manage Information~~

- ~~**CS10 Media Literacy**~~
  1. ~~Analyze Media~~
  2. ~~Create Media Products~~
- ~~**CS11 ICT Literacy**~~
  1. ~~Apply Technology Effectively~~

~~CSS4-Life and Career Skills~~

- ~~**CS12 Flexibility and Adaptability**~~
  1. ~~Adapt to change~~
  2. ~~Be Flexible~~
- ~~**CS13 Initiative and Self-Direction**~~
  1. ~~Manage Goals and Time~~
  2. ~~Work Independently~~
  3. ~~Be Self-directed Learners~~
- ~~**CS14 Social and Cross-Cultural Skills**~~
  1. ~~Interact Effectively with others~~
  2. ~~Work Effectively in Diverse Teams~~
- ~~**CS15 Productivity and Accountability**~~
  1. ~~Manage Projects~~
  2. ~~Produce Results~~
- ~~**CS16 Leadership and Responsibility**~~
  1. ~~Guide and Lead Others~~
  2. ~~Be Responsible to Others~~

~~Appendix D: Common Core Standards~~

~~**Common Core Crosswalk for English/Language Arts (11-12) (Units 1-8)**~~									
	~~**Units**~~	~~**Unit 1**~~	~~**Unit 2**~~	~~**Unit 3**~~	~~**Unit 4**~~	~~**Unit 5**~~	~~**Unit 6**~~	~~**Unit 7**~~	~~**Unit 8**~~
~~**Common Core Standards**~~									
~~RL.11.1.~~		~~X~~							
~~RL.11.2.~~									
~~RL.11.3.~~									
~~RL.11.4.~~				~~X~~		~~X~~	~~X~~		
~~RL.11.5.~~									
~~RL.11.6.~~									
~~RL.11.7.~~									
~~RL.11.8.~~									
~~RL.11.9.~~									
~~RL.11.10.~~									
~~RI.11.1.~~		~~X~~		~~X~~	~~X~~		~~X~~		~~X~~
~~RI.11.2.~~									
~~RI.11.3.~~									
~~RI.11.4.~~				~~X~~	~~X~~	~~X~~	~~X~~		~~X~~
~~RI.11.5.~~									
~~RI.11.6.~~									
~~RI.11.7.~~				~~X~~		~~X~~	~~X~~		
~~RI.11.8.~~									
~~RI.11.9.~~									
~~RI.11.10.~~									
~~W.11.1.~~									
~~W.11.2.~~									
~~W.11.3.~~									
~~W.11.4.~~									
~~W.11.5.~~									
~~W.11.6.~~									
~~W.11.7.~~									
~~W.11.8.~~									
~~W.11.9.~~									
~~W.11.10.~~									
~~SL.11.1.~~									
~~SL.11.2.~~									
~~SL.11.3.~~									
~~SL.11.4.~~				~~X~~		~~X~~	~~X~~		
~~SL.11.5.~~				~~X~~		~~X~~	~~X~~		
~~SL.11.6.~~									
~~L.11.1.~~									
~~L.11.2.~~				~~X~~			~~X~~		
~~L.11.3.~~									
~~L.11.4.~~									
~~L.11.5.~~									
~~L.11.6.~~									
~~RH.11.1.~~									
~~RH.11.2.~~									
~~RH.11.3.~~									
~~RH.11.4.~~									
~~RH.11.5.~~									
~~RH.11.6.~~									
~~RH.11.7.~~									
~~RH.11.8.~~									
~~RH.11.9.~~									
~~RH.11.10.~~									
~~RST.11.1.~~									

~~RST.11.2.~~									
~~RST.11.3.~~			~~X~~	~~X~~	~~X~~				
~~RST.11.4.~~									
~~RST.11.5.~~									
~~RST.11.6.~~									
~~RST.11.7.~~									
~~RST.11.8.~~									
~~RST.11.9.~~									
~~RST.11.10.~~									
~~WHST.11.1.~~									
~~WHST.11.2.~~									
~~WHST.11.3.~~									
~~WHST.11.4.~~									
~~WHST.11.5.~~									
~~WHST.11.6.~~									
~~WHST.11.7.~~									
~~WHST.11.8.~~									
~~WHST.11.9.~~									
~~WHST.11.10.~~									

~~Common Core Crosswalk for English/Language Arts (11-12) (Units 9-17)~~

	~~Units~~	~~Unit 9~~	~~Unit 10~~	~~Unit 11~~	~~Unit 12~~	~~Unit 13~~	~~Unit 14~~	~~Unit 15~~	~~Unit 16~~	~~Unit 17~~
~~Common Core Standards~~										
~~RL.11.1.~~				~~X~~						
~~RL.11.2.~~										
~~RL.11.3.~~										
~~RL.11.4.~~					~~X~~		~~X~~			
~~RL.11.5.~~										
~~RL.11.6.~~										
~~RL.11.7.~~										
~~RL.11.8.~~										
~~RL.11.9.~~										
~~RL.11.10.~~										
~~RI.11.1.~~		~~X~~		~~X~~	~~X~~		~~X~~		~~X~~	
~~RI.11.2.~~										
~~RI.11.3.~~										
~~RI.11.4.~~		~~X~~			~~X~~		~~X~~		~~X~~	
~~RI.11.5.~~										
~~RI.11.6.~~					~~X~~		~~X~~			
~~RI.11.7.~~										
~~RI.11.8.~~										
~~RI.11.9.~~										
~~RI.11.10.~~										
~~W.11.1.~~										
~~W.11.2.~~										
~~W.11.3.~~										
~~W.11.4.~~										
~~W.11.5.~~										
~~W.11.6.~~										
~~W.11.7.~~										
~~W.11.8.~~										
~~W.11.9.~~										
~~W.11.10.~~										
~~SL.11.1.~~										
~~SL.11.2.~~										
~~SL.11.3.~~										
~~SL.11.4.~~							~~X~~			
~~SL.11.5.~~							~~X~~			
~~SL.11.6.~~										
~~L.11.1.~~										
~~L.11.2.~~							~~X~~			
~~L.11.3.~~										
~~L.11.4.~~										
~~L.11.5.~~										
~~L.11.6.~~										
~~RH.11.1.~~										
~~RH.11.2.~~										
~~RH.11.3.~~										
~~RH.11.4.~~										
~~RH.11.5.~~										
~~RH.11.6.~~										
~~RH.11.7.~~										
~~RH.11.8.~~										
~~RH.11.9.~~										
~~RH.11.10.~~										
~~RST.11.1.~~										

~~RST.11.2.~~										
~~RST.11.3.~~										
~~RST.11.4.~~										
~~RST.11.5.~~										
~~RST.11.6.~~										
~~RST.11.7.~~										
~~RST.11.8.~~										
~~RST.11.9.~~										
~~RST.11.10.~~										
~~WHST.11.1.~~										
~~WHST.11.2.~~										
~~WHST.11.3.~~										
~~WHST.11.4.~~										
~~WHST.11.5.~~										
~~WHST.11.6.~~										
~~WHST.11.7.~~										
~~WHST.11.8.~~										
~~WHST.11.9.~~										
~~WHST.11.10.~~										

~~Reading Standards for Literature (11-12)~~

~~College and Career Readiness Anchor Standards for *Reading Literature*~~

~~Key Ideas and Details~~

~~RL.11.1. Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.~~

~~RL.11.2. Determine two or more themes or central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to produce a complex account; provide an objective summary of the text.~~

~~RL.11.3. Analyze the impact of the author's choices regarding how to develop and relate elements of a story or drama (e.g., where a story is set, how the action is ordered, how the characters are introduced and developed).~~

~~Craft and Structure~~

~~RL.11.4. Determine the meaning of words and phrases as they are used in the text, including figurative and connotative meanings; analyze the impact of specific word choices on meaning and tone, including words with multiple meanings or language that is particularly fresh, engaging, or beautiful. (Include Shakespeare as well as other authors.)~~

~~RL.11.5. Analyze how an author's choices concerning how to structure specific parts of a text (e.g., the choice of where to begin or end a story, the choice to provide a comedic or tragic resolution) contribute to its overall structure and meaning as well as its aesthetic impact.~~

~~RL.11.6. Analyze a case in which grasping point of view requires distinguishing what is directly stated in a text from what is really meant (e.g., satire, sarcasm, irony, or understatement).~~

~~Integration of Knowledge and Ideas~~

~~RL.11.7. Analyze multiple interpretations of a story, drama, or poem (e.g., recorded or live production of a play or recorded novel or poetry), evaluating how each version interprets the source text. (Include at least one play by Shakespeare and one play by an American dramatist.)~~

~~RL.11.8. (Not applicable to literature)~~

~~RL.11.9. Demonstrate knowledge of eighteenth-, nineteenth- and early-twentieth-century foundational works of American literature, including how two or more texts from the same period treat similar themes or topics.~~

~~Range of Reading and Level of Text Complexity~~

~~RL.11.10. By the end of grade 11, read and comprehend literature, including stories, dramas, and poems, in the grades 11–CCR text complexity band proficiently, with scaffolding as needed at the high end of the range.~~
~~By the end of grade 12, read and comprehend literature, including stories, dramas, and poems, at the high end of the grades 11–CCR text complexity band independently and proficiently.~~

~~Reading Standards for Informational Text (11-12)~~

~~College and Career Readiness Anchor Standards for *Informational Text*~~

~~Key Ideas and Details~~

~~RI.11.1. Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.~~

~~RI.11.2. Determine two or more central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to provide a complex analysis; provide an objective summary of the text.~~

~~RI.11.3. Analyze a complex set of ideas or sequence of events and explain how specific individuals, ideas, or events interact and develop over the course of the text.~~

~~Craft and Structure~~

~~RI.11.4. Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze how an author uses and refines the meaning of a key term or terms over the course of a text (e.g., how Madison defines faction in Federalist No. 10).~~

~~RI.11.5. Analyze and evaluate the effectiveness of the structure an author uses in his or her exposition or argument, including whether the structure makes points clear, convincing, and engaging.~~

~~RI.11.6. Determine an author's point of view or purpose in a text in which the rhetoric is particularly effective, analyzing how style and content contribute to the power, persuasiveness, or beauty of the text.~~

~~Integration of Knowledge and Ideas~~

~~RI.11.7. Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.~~

~~RI.11.8. Delineate and evaluate the reasoning in seminal U.S. texts, including the application of constitutional principles and use of legal reasoning (e.g., in U.S. Supreme Court majority opinions and dissents) and the premises, purposes, and arguments in works of public advocacy (e.g., The Federalist, presidential addresses).~~

~~RI.11.9. Analyze seventeenth-, eighteenth-, and nineteenth-century foundational U.S. documents of historical and literary significance (including The Declaration of Independence, the Preamble to the Constitution, the Bill of Rights, and Lincoln's Second Inaugural Address) for their themes, purposes, and rhetorical features.~~

~~Range of Reading and Level of Text Complexity~~

~~RI.11.10. By the end of grade 11, read and comprehend literary nonfiction in the grades 11–CCR text complexity band proficiently, with scaffolding as needed at the high end of the range.~~
~~By the end of grade 12, read and comprehend literary nonfiction at the high end of the grades 11–CCR text complexity band independently and proficiently.~~

~~College and Career Readiness Anchor Standards for *Writing*~~

~~Text Types and Purposes~~

~~W.11.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.~~

~~a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences claim(s), counterclaims, reasons, and evidence.~~

~~b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level, concerns, values, and possible biases.~~

~~c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.~~

~~d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.~~

~~e. Provide a concluding statement or section that follows from and supports the argument presented.~~

~~W.11.2. Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.~~

~~a. Introduce a topic; organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.~~

~~b. Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.~~

~~c. Use appropriate and varied transitions and syntax to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.~~

~~d. Use precise language, domain-specific vocabulary, and techniques such as metaphor, simile, and analogy to manage the complexity of the topic.~~

~~e. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.~~

~~f. Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).~~

~~W.11.3. Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.~~

~~a. Engage and orient the reader by setting out a problem, situation, or observation and its significance, establishing one or multiple point(s) of view, and introducing a narrator and/or characters; create a smooth progression of experiences or events.~~

~~b. Use narrative techniques, such as dialogue, pacing, description, reflection, and multiple plot lines, to develop experiences, events, and/or characters~~

~~c. Use a variety of techniques to sequence events so that they build on one another to create a coherent whole and build toward a particular tone and outcome (e.g., a sense of mystery, suspense, growth, or resolution).~~

~~d. Use precise words and phrases, telling details, and sensory language to convey a vivid picture of the experiences, events, setting, and/or characters.~~
~~e. Provide a conclusion that follows from and reflects on what is experienced, observed, or resolved over the course of the narrative.~~

~~Production and Distribution of Writing~~

~~W.11.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)~~

~~W.11.5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (Editing for conventions should demonstrate command of Language standards 1–3 up to and including grades 11–12 on page 54.)~~

~~W.11.6. Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.~~

~~Research to Build and Present Knowledge~~

~~W.11.7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.~~

~~W.11.8. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.~~

~~W.11.9. Draw evidence from literary or informational texts to support analysis, reflection, and research.~~

~~a. Apply grades 11–12 Reading standards to literature (e.g., "Demonstrate knowledge of eighteenth-, nineteenth- and early-twentieth-century foundational works of American literature, including how two or more texts from the same period treat similar themes or topics").~~

~~b. Apply grades 11–12 Reading standards to literary nonfiction (e.g., "Delineate and evaluate the reasoning in seminal U.S. texts, including the application of constitutional principles and use of legal reasoning [e.g., in U.S. Supreme Court Case majority opinions and dissents] and the premises, purposes, and arguments in works of public advocacy [e.g., The Federalist, presidential addresses]").~~

~~Range of Writing~~

~~W.11.10. Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.~~

~~College and Career Readiness Anchor Standards for *Speaking and Listening*~~

~~Comprehension and Collaboration~~

~~SL.11.1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.~~

~~a. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.~~

~~b. Work with peers to promote civil, democratic discussions and decision-making, set clear goals and deadlines, and establish individual roles as needed.~~

~~c. Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.~~

~~d. Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.~~

~~SL.11.2. Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.~~

~~SL.11.3. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, assessing the stance, premises, links among ideas, word choice, points of emphasis, and tone used.~~

~~Presentation of Knowledge and Ideas~~

~~SL.11.4. Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or~~

~~opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.~~

~~SL.11.5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.~~

~~SL.11.6. Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate. (See grades 11–12 Language standards 1 and 3 on page 54 for specific expectations.)~~

~~College and Career Readiness Anchor Standards for *Language*~~

~~Conventions of Standard English~~

~~L.11.1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.~~

~~a. Apply the understanding that usage is a matter of convention, can change over time, and is sometimes contested.~~

~~b. Resolve issues of complex or contested usage, consulting references (e.g., Merriam-Webster's Dictionary of English Usage, Garner's Modern American Usage) as needed.~~

~~L.11.2. Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.~~

~~a. Observe hyphenation conventions.~~

~~b. Spell correctly.~~

~~Knowledge of Language~~

~~L.11.3. Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.~~

~~a. Vary syntax for effect, consulting references (e.g., Tufte's Artful Sentences) for guidance as needed; apply an understanding of syntax to the study of complex texts when reading.~~

~~Vocabulary Acquisition and Use~~

~~L.11.4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 11–12 reading and content, choosing flexibly from a range of strategies.~~

~~a. Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.~~

~~b. Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., conceive, conception, conceivable).~~

~~c. Consult general and specialized reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning, its part of speech, its etymology, or its standard usage.~~

~~d. Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary).~~

~~L.11.5. Demonstrate understanding of figurative language, word relationships, and nuances in word meanings.~~

~~a. Interpret figures of speech (e.g., hyperbole, paradox) in context and analyze their role in the text.~~
~~b. Analyze nuances in the meaning of words with similar denotations.~~

~~L.11.6. Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.~~

~~Reading Standards for Literacy in History/Social Studies (11-12)~~

~~Key Ideas and Details~~

~~RH.11.1 Cite specific textual evidence to support analysis of primary and secondary sources, connecting insights gained from specific details to an understanding of the text as a whole.~~

~~RH.11.2. Determine the central ideas or information of a primary or secondary source; provide an accurate summary that makes clear the relationships among the key details and ideas~~

~~RH.11.3. Evaluate various explanations for actions or events and determine which explanation best accords with textual evidence, acknowledging where the text leaves matters uncertain~~

~~Craft and Structure~~

~~RH.11.4. Determine the meaning of words and phrases as they are used in a text, including analyzing how an author uses and refines the meaning of a key term over the course of a text (e.g., how Madison defines faction in Federalist No. 10).~~

~~RH.11.5. Analyze in detail how a complex primary source is structured, including how key sentences, paragraphs, and larger portions of the text contribute to the whole.~~

~~RH.11.6. Evaluate authors' differing points of view on the same historical event or issue by assessing the authors' claims, reasoning, and evidence.~~

~~Integration of Knowledge and Ideas~~

~~RH.11.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem.~~

~~RH.11.8. Evaluate an author's premises, claims, and evidence by corroborating or challenging them with other information.~~

~~RH.11.9. Integrate information from diverse sources, both primary and secondary, into a coherent understanding of an idea or event, noting discrepancies among sources.~~

~~Range of Reading and Level of Text Complexity~~

~~RH.11.10. By the end of grade 12, read and comprehend history/social studies texts in the grades 11–CCR text complexity band independently and proficiently.~~

~~Reading Standards for Literacy in Science and Technical Subjects (11-12)~~

~~Key Ideas and Details~~

~~RST.11.1. Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.~~

~~RST.11.2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.~~

~~RST.11.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.~~

~~Craft and Structure~~

~~RST.11.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.~~

~~RST.11.5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.~~

~~RST.11.6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.~~

~~Integration of Knowledge and Ideas~~

~~RST.11.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.~~

~~RST.11.8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.~~

~~RST.11.9. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.~~

~~Range of Reading and Level of Text Complexity~~

~~RST.11.10. By the end of grade 12, read and comprehend science/technical texts in the grades 11–CCR text complexity band independently and proficiently.~~

~~Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects (11-12)~~

~~Text Types and Purposes~~

~~WHST.11.1. Write arguments focused on discipline-specific content.~~

~~a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.~~

~~b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and~~

~~limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.~~

~~c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.~~

~~d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.~~

~~e. Provide a concluding statement or section that follows from or supports the argument presented.~~

~~WHST.11.2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.~~

~~a. Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.~~

~~b. Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.~~

~~c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.~~

~~d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.~~

~~e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).~~

~~WHST.11.3. (Not applicable as a separate requirement)~~

~~Production and Distribution of Writing~~

~~WHST.11.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. Produce clear and coherent~~

~~writing in which the development, organization, and style are appropriate to task, purpose, and audience.~~

~~WHST.11.5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.~~

~~WHST.11.6. Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.~~

~~Research to Build and Present Knowledge~~

~~WHST.11.7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.~~

~~WHST.11.8. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.~~

~~WHST.11.9. Draw evidence from informational texts to support analysis, reflection, and research.~~

~~Range of Writing~~

~~WHST.11.10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.~~

~~Common Core Crosswalk for Mathematics (11-12)~~
~~(Units 1-8)~~

	~~Units~~	~~Unit 1~~	~~Unit 2~~	~~Unit 3~~	~~Unit 4~~	~~Unit 5~~	~~Unit 6~~	~~Unit 7~~	~~Unit 8~~
~~Common Core Standards~~									
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	~~Common Core Crosswalk for Mathematics (11-12) (Units 9-17)~~									
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~~**Mathematics (High School)**~~

~~**Number and Quantity**~~

~~The Real Number System~~

~~N-RN.1. Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.~~

~~N-RN.2. Rewrite expressions involving radicals and rational exponents using the properties of exponents.~~

~~N-RN.3. Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.~~

~~Quantities~~

~~N-Q.1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.~~

~~N-Q.2. Define appropriate quantities for the purpose of descriptive modeling.~~

~~N-Q.3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.~~

~~The Complex Number System~~

~~N-CN.1. Know there is a complex number i such that i2= −1, and every complex number has the form a + bi with a and b real.~~

~~N-CN.2. Use the relation i2= −1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.~~

~~N-CN.3. (+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.~~

~~N-CN.4. (+) Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.~~

~~N-CN.5. (+) Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for~~

~~computation. For example, (−1 + √3 i)3= 8 because (−1 + √3 i) has modulus 2 and argument 120°.~~

~~N-CN.6. (+) Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints.~~

~~N-CN.7. Solve quadratic equations with real coefficients that have complex solutions.~~

~~N-CN.8. (+) Extend polynomial identities to the complex numbers. For example, rewrite x2+ 4 as (x + 2i)(x − 2i).~~

~~N-CN.9. (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.~~

~~Vector and Matrix Quantities~~

~~N-VM.1. (+) Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., v, |v|, ||v||, v).~~

~~N-VM.2. (+) Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.~~

~~N-VM.3. (+) Solve problems involving velocity and other quantities that can be represented by vectors.~~

~~N-VM.4. (+) Add and subtract vectors~~

~~N-VM.4.a. Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.~~

~~N-VM.4.b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.~~

~~N-VM.4.c. Understand vector subtraction v − w as v + (−w), where −w is the additive inverse of w, with the same magnitude as w and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.~~

~~N-VM.5. (+) Multiply a vector by a scalar.~~

~~N-VM.5.a. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as c(vx, vy) = (cvx, cvy).~~

~~N-VM.5.b. Compute the magnitude of a scalar multiple cv using ||cv|| = |c|v. Compute the direction of cv knowing that when |c|v ≠ 0, the direction of cv is either along v (for c > 0) or against v (for c < 0).~~

~~N-VM.6. (+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.~~

~~N-VM.7. (+) Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.~~

~~N-VM.8. (+) Add, subtract, and multiply matrices of appropriate dimensions.~~

~~N-VM.9. (+) Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties~~

~~N-VM.10. (+) Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.~~

~~N-VM.11. (+) Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors.~~

~~N-VM.12. (+) Work with 2 × 2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area.~~

~~Algebra~~

~~Seeing Structure in Expressions~~

~~A-SSE.1. Interpret expressions that represent a quantity in terms of its context.~~

~~A-SSE.1.a. Interpret parts of an expression, such as terms, factors, and coefficients.~~

~~A-SSE.1.b. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)n as the product of P and a factor not depending on P.~~

~~A-SSE.2. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.~~

~~A-SSE.3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.~~

~~A-SSE.3.a. Factor a quadratic expression to reveal the zeros of the function it defines.~~

~~A-SSE.3.b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.~~

~~A-SSE.3.c. Use the properties of exponents to transform expressions for exponential functions.~~

~~A-SSE.4. Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments.~~

~~Arithmetic with Polynomials and Rational Expressions~~

~~A-APR.1. Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials~~

~~A-APR.2. Know and apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x – a is p(a), so p(a) = 0 if and only if (x – a) is a factor of p(x).~~

~~A-APR.3. Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.~~

~~A-APR.4. Prove polynomial identities and use them to describe numerical relationships.~~

~~A-APR.5. (+) Know and apply the Binomial Theorem for the expansion of (x+ y)n in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.~~

~~A-APR.6. Rewrite simple rational expressions in different forms; write a(x)/b(x)in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.~~

~~A-APR.7. (+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.~~

~~Creating Equations~~

~~A-CED.1. Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.~~

~~A-CED.2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.~~

~~A-CED.3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.~~

~~A-CED.4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V =IR to highlight resistance R.~~

~~Reasoning with Equations and Inequalities~~

~~A-REI.1. Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.~~

~~A-REI.2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.~~

~~A-REI.3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.~~

~~A-REI.4. Solve quadratic equations in one variable.~~

> ~~A-REI.4.a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form (x − p)2= q that has the same solutions. Derive the quadratic formula from this form.~~
>
> ~~A-REI.4.b. Solve quadratic equations by inspection (e.g., for x2= 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real numbers a and b.~~

~~A-REI.5. Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.~~

~~A-REI.6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.~~

~~A-REI.7. Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line y = −3x and the circle x2+y2= 3.~~

~~A-REI.8. (+) Represent a system of linear equations as a single matrix equation in a vector variable.~~

~~A-REI.9. (+) Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3 × 3 or greater).~~

~~A-REI.10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).~~

~~A-REI.11. Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.~~

~~A-REI.12.Graph the solutions to a linear inequality in two variables as a half plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.~~

~~Functions~~

~~Interpreting Functions~~

~~F-IF.1. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).~~

~~F-IF.2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.~~

~~F-IF.3. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1.~~

~~F-IF.4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.~~

~~F-IF.5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.~~

~~F-IF.6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.~~

~~F-IF.7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.~~

~~F-IF.7.a. Graph linear and quadratic functions and show intercepts, maxima, and minima.~~

~~F-IF.7.b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.~~

~~F-IF.7.c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.~~

~~F-IF.7.d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.~~

~~F-IF.7.e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.~~

~~F-IF.8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.~~

~~F-IF.8.a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.~~

~~F-IF.8.b. Use the properties of exponents to interpret expressions for exponential functions.~~

~~F-IF.9. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.~~

~~Building Functions~~

~~F-BF.1. Write a function that describes a relationship between two quantities.~~

~~F-BF.1.a. Determine an explicit expression, a recursive process, or steps for calculation from a context.~~

~~F-BF.1.b. Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.~~

~~F-BF.1.c. (+) Compose functions. For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.~~

~~F-BF.2. Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.~~

~~F-BF.3. Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.~~

~~F-BF.4. Find inverse functions.~~

~~F-BF.4.a. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse.~~

~~F-BF.4.b. (+) Verify by composition that one function is the inverse of another.~~

~~F-BF.4.c. (+) Read values of an inverse function from a graph or a table, given that the function has an inverse.~~

~~F-BF.4.d. (+) Produce an invertible function from a non-invertible function by restricting the domain.~~

~~F-BF.5. (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.~~

~~Linear, Quadratic, and Exponential Models~~

~~F-LE.1. Distinguish between situations that can be modeled with linear functions and with exponential functions.~~

~~F-LE.1.a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.~~

~~F-LE.1.b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.~~

~~F-LE.1.c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another~~

~~F-LE.2. Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).~~

~~F-LE.3. Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.~~

~~F-LE.4. For exponential models, express as a logarithm the solution to ab ct = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.~~

~~F-LE.5. Interpret the parameters in a linear or exponential function in terms of a context.~~

~~Trigonometric Functions~~

~~F-TF.1. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.~~

~~F-TF.2. Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.~~

~~F-TF.3. (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π/6, and use the unit circle to express the values of sine, cosine, and tangent for π - x, π+x, and 2π - x in terms of their values for x, where x is any real number.~~

~~F-TF.4. (+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.~~

~~F-TF.5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.~~

~~F-TF.6. (+) Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.~~

~~F-TF.7. (+) Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.~~

~~F-TF.8. Prove the Pythagorean identity sin2 (θ) + cos 2 (θ) = 1 and use it to find sin(θ), cos(θ), or tan(θ) given sin(θ), cos(θ), or tan(θ) and the quadrant of the angle.~~

~~F-TF.9. (+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.~~

~~**Geometry**~~

~~Congruence~~

~~G-CO.1. Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.~~

~~G-CO.2. Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).~~

~~G-CO.3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.~~

~~G-CO.4. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.~~

~~G-CO.5. Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.~~

~~G-CO.6. Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.~~

~~G-CO.7. Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.~~

~~G-CO.8. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.~~

~~G-CO.9. Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.~~

~~G-CO.10. Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.~~

~~G-CO.11. Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.~~

~~G-CO.12. Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.~~

~~G-CO.13. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.~~

~~Similarity, Right Triangles, and Trigonometry~~

~~G-SRT.1. Verify experimentally the properties of dilations given by a center and a scale factor:~~

~~G-SRT.1.a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.~~

~~G-SRT.1.b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.~~

~~G-SRT.2. Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.~~

~~G-SRT.3. Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.~~

~~G-SRT.4. Prove theorems about triangles. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.~~

~~G-SRT.5. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.~~

~~G-SRT.6. Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.~~

~~G-SRT.7. Explain and use the relationship between the sine and cosine of complementary angles.~~

~~G-SRT.8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.~~

~~G-SRT.9. (+) Derive the formula A = 1/2 ab sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.~~

~~G-SRT.10. (+) Prove the Laws of Sines and Cosines and use them to solve problems.~~

~~G-SRT.11. (+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).~~

~~Circles~~

~~G-C.1. Prove that all circles are similar.~~

~~G-C.2. Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.~~

~~G-C.3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.~~

~~G-C.4. (+) Construct a tangent line from a point outside a given circle to the circle.~~

~~G-C.5. Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.~~

~~Expressing Geometric Properties with Equations~~

~~G-GPE.1. Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.~~

~~G-GPE.2. Derive the equation of a parabola given a focus and directrix.~~

~~G-GPE.3. (+) Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.~~

~~G-GPE.4. Use coordinates to prove simple geometric theorems algebraically. For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).~~

~~G-GPE.5. Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).~~

~~G-GPE.6. Find the point on a directed line segment between two given points that partitions the segment in a given ratio.~~

~~G-GPE.7. Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.~~

~~Geometric Measurement and Dimension~~

~~G-GMD.1. Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri's principle, and informal limit arguments.~~

~~G-GMD.2. (+) Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.~~

~~G-GMD.3. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.~~

~~G-GMD.4. Identify the shapes of two-dimensional cross-sections of three dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.~~

~~Modeling with Geometry~~

~~G-MG.1. Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).~~

~~G-MG.2. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).~~

~~G-MG.3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).~~

~~Statistics and Probability~~

~~Interpreting Categorical and Quantitative Data~~

~~S-ID.1. Represent data with plots on the real number line (dot plots, histograms, and box plots).~~

~~S-ID.2. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.~~

~~S-ID.3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).~~

~~S-ID.4. Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate.~~
~~Use calculators, spreadsheets, and tables to estimate areas under the normal curve.~~

~~S-ID.5. Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.~~

~~S-ID.6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.~~

~~S-ID.6.a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.~~

~~S-ID.6.b. Informally assess the fit of a function by plotting and analyzing residuals.~~

~~S-ID.6.c. Fit a linear function for a scatter plot that suggests a linear association.~~

~~S-ID.7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.~~

~~S-ID.8. Compute (using technology) and interpret the correlation coefficient of a linear fit.~~

~~S-ID.9. Distinguish between correlation and causation.~~

~~Making Inferences and Justifying Conclusions~~

~~S-IC.1. Understand statistics as a process for making inferences about population parameters based on a random sample from that population.~~

~~S-IC.2. Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?~~

~~S-IC.3. Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.~~

~~S-IC.4. Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.~~

~~S-IC.5. Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.~~

~~S-IC.6. Evaluate reports based on data.~~

~~Conditional Probability and the Rules of Probability~~

~~S-CP.1. Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").~~

~~S-CP.2. Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.~~

~~S-CP.3. Understand the conditional probability of A given B as P(A and B)/P(B), and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.~~

~~S-CP.4. Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.~~

~~S-CP.5. Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. For example, compare the chance of~~

~~having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.~~

~~S-CP.6. Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.~~

~~S-CP.7. Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model.~~

~~S-CP.8. (+) Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model.~~

~~S-CP.9. (+) Use permutations and combinations to compute probabilities of compound events and solve problems.~~

~~Using Probability to Make Decisions~~

~~S-MD.1. (+) Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions.~~

~~S-MD.2. (+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.~~

~~S-MD.3. (+) Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value. For example, find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.~~

~~S-MD.4. (+) Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. For example, find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households?~~

~~S-MD.5. (+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.~~

> ~~S-MD.5.a. Find the expected payoff for a game of chance. For example, find the expected winnings from a state lottery ticket or a game at a fast-food restaurant.~~
>
> ~~S-MD.5.b. Evaluate and compare strategies on the basis of expected values. For example, compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.~~

~~S-MD.6. (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).~~

~~S-MD.7. (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).~~

~~Appendix E: National Educational Technology Standards for Students (NETS-S)~~

~~NETS Crosswalk for Industrial Maintenance~~									
	~~Course~~	~~Unit 1~~	~~Unit 2~~	~~Unit 3~~	~~Unit 4~~	~~Unit 5~~	~~Unit 6~~	~~Unit 7~~	~~Unit 8~~
~~NETS Standards~~									
~~T1~~		~~X~~	~~X~~	~~X~~	~~X~~				
~~T2~~		~~X~~	~~X~~	~~X~~	~~X~~		~~X~~		
~~T3~~		~~X~~		~~X~~	~~X~~				~~X~~
~~T4~~		~~X~~	~~X~~	~~X~~	~~X~~				
~~T5~~		~~X~~	~~X~~						
~~T6~~		~~X~~	~~X~~	~~X~~	~~X~~				

	~~NETS Crosswalk for Industrial Maintenance~~									
	~~Course~~	~~Unit 9~~	~~Unit 10~~	~~Unit 11~~	~~Unit 12~~	~~Unit 13~~	~~Unit 14~~	~~Unit 15~~	~~Unit 16~~	~~Unit 17~~
~~NETS Standards~~										
~~T1~~				~~X~~			~~X~~			
~~T2~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
~~T3~~										
~~T4~~										
~~T5~~										
~~T6~~									~~X~~	~~X~~

~~**T1** Creativity and Innovation~~
~~**T2** Communication and Collaboration~~
~~**T3** Research and Information Fluency~~
~~**T4** Critical Thinking, Problem Solving, and Decision Making~~
~~**T5** Digital Citizenship~~
~~**T6** Technology Operations and Concepts~~

~~**T1** Creativity and Innovation~~

~~Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students do the following:~~

~~a. Apply existing knowledge to generate new ideas, products, or processes.~~
~~b. Create original works as a means of personal or group expression.~~
~~c. Use models and simulations to explore complex systems and issues.~~
~~d. Identify trends and forecast possibilities.~~

~~**T2** Communication and Collaboration~~

~~Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students do the following:~~

~~a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.~~
~~b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.~~
~~c. Develop cultural understanding and global awareness by engaging with learners of other cultures.~~
~~d. Contribute to project teams to produce original works or solve problems.~~

~~**T3** Research and Information Fluency~~

~~Students apply digital tools to gather, evaluate, and use information. Students do the following:~~

~~a. Plan strategies to guide inquiry.~~
~~b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.~~
~~c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.~~
~~d. Process data and report results.~~

~~**T4** Critical Thinking, Problem Solving, and Decision Making~~

~~Students use critical-thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students do the following:~~

~~a. Identify and define authentic problems and significant questions for investigation.~~
~~b. Plan and manage activities to develop a solution or complete a project.~~
~~c. Collect and analyze data to identify solutions and/or make informed decisions.~~
~~d. Use multiple processes and diverse perspectives to explore alternative solutions.~~

~~**T5** Digital Citizenship~~

~~Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. Students do the following:~~

~~a. Advocate and practice safe, legal, and responsible use of information and technology.~~

~~b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity.~~

~~c. Demonstrate personal responsibility for lifelong learning.~~

~~d. Exhibit leadership for digital citizenship.~~

~~**T6** Technology Operations and Concepts~~

~~Students demonstrate a sound understanding of technology concepts, systems, and operations. Students do the following:~~

~~a. Understand and use technology systems.~~

~~b. Select and use applications effectively and productively.~~

~~c. Troubleshoot systems and applications.~~

~~d. Transfer current knowledge to learning of new technologies.~~