Knowledge	Skills	Performance Element	Measurement Criteria	15.1306 Mechanical Drafting & Mechanical Drafting CAD/ CADD Consolidated (2011)
I				**ACADEMIC FOUNDATIONS**
	A			**Demonstrate language arts knowledge and skills required to pursue the full range of post-secondary education and career opportunities.**
		1		Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice.
		2		Demonstrate use of the concepts, strategies, and systems for obtaining and conveying ideas and information to enhance communication in the workplace.
		3		Locate, organize and reference written information from various sources to communicate with co-workers and clients/participants.
		4		Evaluate and use information resources to accomplish specific occupational tasks.
		5		Use correct grammar, punctuation and terminology to write and edit documents.
		6		Develop and deliver formal and informal presentations using appropriate media to engage and inform audiences.
		7		Interpret verbal and nonverbal cues/behaviors to enhance communication with co-workers and clients/participants.
		1		Identify whole numbers, decimals, and fractions.
		2		Demonstrate knowledge of basic arithmetic operations such as addition, subtraction, multiplication, and division.
		3		Demonstrate use of relational expressions such as equal to, not equal, greater than, less than, etc.
		4		Apply data and measurements to solve a problem.
		5		Analyze Mathematical problem statements for missing and/or irrelevant data.
		6		Construct charts/tables/graphs from functions and data.
		7		Analyze data when interpreting operational documents.
	B			**Demonstrate science knowledge and skills required to pursue the full range of post-secondary and career education opportunities.**
		1		Evaluate scientific constructs including conclusions, conflicting data, controls, data, inferences, limitations, questions, sources of errors, and variables.
		2		Apply scientific methods in qualitative and quantitative analysis, data gathering, direct and indirect observation, predictions, and problem identification.
		3		Explain the relationships between scientific theory, scientific principles and laws, in technology, and engineering.
	C			**Demonstrate the ability to select, apply, and convert systems of measurement to solve problems.**
		1		Apply scalar and vector quantities as applied to physical systems, such as the relationship between position, velocity, and acceleration.
		2		Apply fundamental laws and principles relevant to engineering and technology.
	D			**Demonstrate the ability to use Newton's Laws of Motion to analyze static and dynamic systems with and without the presence of external forces.**
		1		Use the laws of conservation of energy, charge, and momentum, to solve a variety of problems involving mechanical, fluid, chemical, biological, electrical, and thermal systems.
		2		Use the relationships between energy, work, and power to solve a variety of problems involving mechanical, fluid, electrical, and thermal systems.
		3		Use the principles of ray optics to describe reflection and refraction of light.
II				**COMMUNICATIONS**
	A			**Develop and interpret tables, charts, and figures to support written and oral communications.**
		1		Create tables, charts, and figures to support written and oral communications.
		2		Interpret tables, charts, and figures used to support written and oral communication.
	B			**Apply active listening skills to obtain and clarify information.**
		1		Interpret a given verbal message/information.
		2		Respond with restatement and clarification techniques to clarify information.
		3		Model behaviors that demonstrate active listening.
	C			**Listen to and speak with diverse individuals to enhance communication skills.**
		1		Apply factors and strategies for communicating with a diverse workforce.
		2		Demonstrate ability to communicate and resolve conflicts within a diverse workforce.
	D			**Apply active listening skills to obtain or clarify information pertaining to plans, processes, projects, or designs.**
		1		Interpret messages or information provided that clarifies issues, ideas, plans, projects, or processes.
		2		Respond and/or restate information that will clarify STEM techniques to be used and/or information to be applied to projects, plans, or processes.
	E			**Prepare STEM material in oral, written, or visual formats that provide information to an intended audience to fulfill specific communication need of an audience.**
		1		Use effective methods to communicate concepts of STEM to a broadly represented audience.
		2		Effectively communicate STEM information to a select audience.

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		3		Apply the ability to read, interpret, and analyze STEM materials discerning the information and concepts.
	F			**Exhibit public relations skills to increase internal and external customer/client satisfaction.**
		1		Communicate effectively when developing positive customer/client relationships.
		2		Use correct grammar to communicate verbally.
		3		Listen to a presentation and record important information. Report back identifying central themes and use key points to explain how the message applies to a similar situation.
III				**PROBLEM-SOLVING AND CRITICAL THINKING**
	A			**Effectively develop and apply the skills inherent in systems engineering where requirements, configuration, integration, project management, quality assurance, and process applications are necessary.**
		1		Employ critical thinking skills independently and in teams to solve problems and make decisions (e.g., analyze, synthesize and evaluate).
		2		Use the skills required in project management to track and assess the progress of a plan, process, or project as assigned.
		3		Apply the skills in quality assurance as well as those in process management and development for appropriate applications of systems integration techniques to an assigned project.
		4		Employ critical thinking and interpersonal skills to resolve conflicts with staff and/or customers.
		5		Identify, write and monitor workplace performance goals to guide progress in assigned areas of responsibility and accountability.
		6		Conduct technical research to gather information necessary for decision-making.
	B			**Use mathematics, science, and technology concepts and processes to solve problems in projects involving design and/or production (e.g. medical, agricultural, biotechnological, energy and power, information and communication, transportation, manufacturing, and construction).**
		1		Apply the core concepts of technology and recognize the relationships with STEM systems (e.g. systems, resources, criteria and constraints, optimization and trade-off, and controls).
		2		Develop the active use of information technology applications.
		3		Use computer applications to solve problems by creating and using algorithms, and through simulation and modeling techniques.
IV				**INFORMATION TECHNOLOGY APPLICATIONS**
	A			**Use Personal Information Management (PIM) applications to increase workplace efficiency.**
		1		Manage personal schedules and contact information.
		2		Create memos and notes.
	B			**Employ technological tools to expedite workflow.**
		1		Use information technology tools to manage and perform work responsibilities.
		2		Use email to share files and documents.
		3		Identify the functions and purpose of email systems.
		4		Use email to communicate within and across organizations.
		5		Access and navigate Internet (e.g., use a web browser).
		6		Search for information and resources.
		7		Evaluate Internet resources for reliability and validity.
		8		Prepare simple documents and other business communications.
		9		Prepare reports and other business communications by integrating graphics and other non-text elements.
		10		Prepare complex multi-media publications.
		11		Prepare presentations for training, sales and information sharing.
		12		Deliver presentations with supporting materials.
		13		Create a spreadsheet.
		14		Perform calculations and analyses on data using a spreadsheet.
		15		Manipulate data elements.
		16		Manage interrelated data elements.
		17		Analyze interrelated data elements.
		18		Generate reports showing interrelated data elements.
		19		Facilitate group work through management of shared schedule and contact information.
		20		Facilitate group work through management of shared files and online information.
		21		Facilitate group work through instant messaging or virtual meetings.
		22		Manage computer operations.
		23		Manage file storage.
		24		Compress or alter files.
		25		Operate computer driven equipment and machines.
		26		Use installation and operation manuals.
		27		Troubleshoot computer driven equipment and machines.
		28		Access support as needed to maintain operation of computer driven equipment and machines.
		29		Use IT in support of gathering, storage, and transfer of data or results in appropriate formats to support assigned projects.

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		30		Select and use assorted forms of IT to meet the requirements of a plan, process, project, report, issue, or problem.
	C			**Demonstrate Digital Citizenship**
		1		Identify legal and ethical issues related to the use of information and communication technologies (e.g., properly selecting and citing resources)
		2		Discuss possible long-range effects of unethical uses of technology (e.g., virus spreading, file pirating, hacking) on cultures and society
		3		Discuss and demonstrate proper netiquette in online communications
		4		Identify ways that individuals can protect their technology systems from unethical or unscrupulous users
		5		Create appropriate citations for resources when presenting research findings
		6		Discuss and adhere to fair use policies and copyright guidelines
	D			**Evaluate and use skills relating to the differing technological tools used to manipulate, report, or operate with data acquisition.**
		1		Use IT tools to manipulate data creating reports, plans, processes, or projects from data provided.
		2		Use modeling, simulation, or visual reproduction to effectively analyze, create, and/or communicate to others regarding plans, projects, problems, issues or processes.
		3		Apply a currently applicable computer programming language to a process, project, plan, or issue as assigned.
		4		Apply statistical tools that verify the reliability or validity of the data used or collected in the plan, project, process, or problem.
		5		Apply a technological, scientific, or mathematical concept (use of algorithms) when communicating with others on issues, plans, processes, problems, or concepts.
	E			**Select and use different forms of communications technology including word processing, spreadsheets, database, presentation software, email to communicate, and use of the internet to search for and display information.**
		1		Select and use information technology tools to collect, analyze, synthesize, and display data to solve problems.
		2		Read and create basic computer aided engineering drawings.
V				**SYSTEMS**
	A			**Describe the nature and types of business organizations to build an understanding of the scope of organizations.**
		1		Describe the types and functions of businesses.
		2		Explain the functions and interactions of common departments within a business.
	B			**Implement quality control systems and practices to ensure quality products and services.**
		1		Describe quality control standards and practices common to the workplace.
		2		Diagnose and make necessary corrections or improvements to a technical system in a business, industry, or simulated work place setting.
VI				**SAFETY, HEALTH AND ENVIRONMENTAL**
	A			**Apply safety practices in the environment where science, technology, engineering, and/or mathematical principles are appropriate to ensure a safe workplace.**
		1		Assess workplace conditions with regard to safety and health.
		2		Select appropriate personal protective equipment as needed for a safe workplace/jobsite.
		3		Employ a safety hierarchy and communication system within the workplace/jobsite.
		4		Implement safety precautions to maintain a safe worksite.
		5		Use appropriate safety techniques, equipment, and processes in planning and /or project applications.
	B			**Develop an awareness of safety, health, and environmental hazards inherent in the STEM arenas when solving problems, developing plans, processes, or completing projects to be proactive in promoting safety.**
		1		Identify existing or potential hazards to existing or assigned plans, projects, or processes where safety, health, or environment might be in play.
	C			**Employ emergency procedures as necessary to provide aid in workplace accidents.**
		1		Use knowledge of First Aid procedures as necessary.
		2		Use knowledge of CPR procedures as necessary.
		3		Use safety equipment as necessary.
	D			**Employ knowledge of response techniques to create a disaster and/or emergency response plan.**
		1		Complete an assessment of an emergency and/or disaster situation.
		2		Create an emergency and/or disaster plan.
VII				**LEADERSHIP AND TEAMWORK**
	A			**Use leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.**
		1		Employ leadership skills to accomplish organizational goals and objectives.

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		2		Employ organizational and staff development skills to foster positive working relationships and accomplish organizational goals.
		3		Employ teamwork skills to achieve collective goals and use team members' talents effectively.
		4		Establish and maintain effective working relationships with all levels of personnel and other departments in order to accomplish objectives and tasks.
		5		Conduct and participate in meetings to accomplish work tasks.
		6		Employ mentoring skills to inspire and teach others.
VIII				**ETHICS AND LEGAL RESPONSIBILITIES**
	A			**Develop the knowledge and abilities to comprehend ethical and legal standards as they apply to STEM where plans, processes, and projects will be dependent upon them.**
		1		Apply ethical reasoning to a variety of workplace situations in order to make ethical decisions.
		2		Interpret and explain written organizational policies and procedures to help employees perform their jobs according to employer rules and expectations.
		3		Demonstrate the skill of application to ethical and legal standards as they apply to the plans, processes, and projects as assigned in simulated environments.
IX				**EMPLOYABILITY AND CAREER DEVELOPMENT**
	A			**Know and understand the importance of employability skills.**
		1		Identify and demonstrate positive work behaviors and personal qualities needed to be employable.
		2		Manage resources in relation to the position (i.e. budget, supplies, computer, etc).
	B			**Explore, plan, and effectively manage careers.**
		1		Develop a personal career plan to meet career goals and objectives.
		2		Identify and explore career opportunities in one or more career pathways to build an understanding of the opportunities available in the cluster.
		3		Recognize and act upon requirements for career advancement to plan for continuing education and training.
		4		Continue professional development to keep current on relevant trends and information within the industry.
		5		Examine licensing, certification and credentialing requirements at the national, state and local levels to maintain compliance with industry requirements.
		6		Examine employment opportunities in entrepreneurship to consider entrepreneurship as an option for career planning.
	C			**Demonstrate skills related to seeking and applying for employment to find and obtain a desired job.**
		1		Use multiple resources to locate job opportunities.
		2		Prepare a résumé.
		3		Prepare a letter of application.
		4		Complete an employment application.
		5		Interview for employment.
		6		List the standards and qualifications that must be met in order to enter a given industry.
		7		Employ critical thinking and decision-making skills to exhibit qualifications to a potential employer.
		8		Maintain a career portfolio to document knowledge, skills and experience in a career field.
		9		Demonstrate skills in evaluating and comparing employment opportunities in order to accept employment positions that match career goals.
		10		Identify and exhibit traits for retaining employment to maintain employment once secured.
		11		Engage experiences in STEM where an individual can identify personal interests and expectations for career and personal development.
X				**TECHNICAL SKILLS**
	A			**Employ information management techniques and strategies in the workplace to assist in decision-making.**
		1		Use information literacy skills when accessing, evaluating and disseminating information.
		2		Describe the nature and scope of information management.
		3		Maintain records to facilitate ongoing business operations.
	B			**Employ planning and time management skills and tools to enhance results and complete work tasks.**
		1		Develop goals and objectives.
		2		Prioritize tasks to be completed.
		3		Develop timelines using time management knowledge and skills.
		4		Use project-management skills to improve workflow and minimize costs.
	C			**Apply concepts and processes for the application of technology to engineering.**
		1		Use knowledge, techniques, skills, and modern tools necessary for engineering practice.
		2		Describe the elements of good engineering practice (e.g. understanding customer needs, planning requirements analysis, using appropriate engineering tools, prototyping, test, evaluation, and verification).
		3		Demonstrate the ability to characterize a plan and identify the necessary engineering tools that will produce a technical solution when given a problem statement.

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		4		Effectively use project management techniques (e.g. working in teams, appropriate time management practices, effective organizational skills, conduct analysis of cost, resources, and production capacity, and quality practices with continuous improvement).
		5		Use and calibrate probes, sensors, measuring systems, and devices to collect data using traceable standards.
		6		Explain the impact of error in measurement, predict the effect of error propagation in calculations, and record data with the correct number of significant digits.
		7		Safely operate a variety of tools, machines, and equipment (e.g. milling machines, rapid prototyping machines, drill press, band saw, CNC machines, and hand tools).
		8		Use, handle, and store tools and materials correctly, perform preventative maintenance, understanding the results of negligence and improper maintenance or improper calibration.
	D			**Preparing to Draw: Basic Drawing and Dimensioning Skills**
		1		Measure lines, angles, and geometric features
		2		Identify drawing views and details
		3		Identify assembly drawings, detailed drawings, and other drawings by type
		4		Identify revisions and apply engineering change information
		5		Identify and create line types
		6		Identify and create sketches
		7		Complete title block and apply reference information
		8		Identify and complete a parts list/bill of materials
		9		Select and interpret scale and paper size
		10		Identify and operate design tools/instruments (CAD and./or manual)
		11		Identify reference charts and tables
	E			**Applied Mathematics**
		1		Demonstrate knowledge of mathematical operations
		2		Demonstrate knowledge of geometry
		3		Demonstrate knowledge of trigonometry
	F			**Identify Measurements**
		1		Identify and read precision measurement tools
		2		Calculate unit conversion
	G			**Geometric Construction**
		1		Draw lines and curved elements
		2		Construct perpendicular and parallel lines
		3		Construct tangent lines and arcs
		4		Construct geometric shapes
		5		Identify and construct developments
		6		Bisect and divide geometric elements
	H			**Engineering Drawings**
		1		Demonstrate knowledge of assembly and exploded assembly drawings
		2		Identify abbreviations and symbols
		3		Demonstrate knowledge of pictorial drawings
	I			**Multiview Drawings**
		1		Demonstrate knowledge of multiview drawings
		2		Multiview projection (third angle and first angle)
		3		Differentiate between major surface types (normal, inclined, oblique, cylindrical)
		4		Identify common part features (fillets, rounds, draft angles, chamfers)
	J			**Section Views**
		1		Identify and construct section views
		2		Identify ANSI material symbols
		3		Apply section rules
	K			**Auxiliary Views**
		1		Identify and construct auxiliary views
		2		Draw true view, true length lines, and true angles
	L			**Dimensioning Skills**
		1		Locate and describe features
		2		Demonstrate knowledge of various unit dimensioning systems
		3		Identify finished surfaces
		4		Demonstrate knowledge of tolerances
		5		Identify and label common mechanical feature notations
		6		Place local and general notes including fonts, lettering size, style, etc.
		7		Identify geometric dimensioning and tolerancing symbols
		8		Identify measurements
XI				**ENGINEERING TECHNOLOGY PATHWAY**
	A			**Know the elements of the processes and concepts for understanding the design process.**
		1		Explain why and how the contributions of great innovators are important to society.
		2		Explain the elements and steps of the design process and tools or techniques that can be used for each step.
		3		Describe design constraints, criteria, and trade-offs in regard to variety of conditions (e.g. technology, cost, safety, society, the environment, time, human resources, manufacturability).
	B			**Develop processes and concepts to apply the design process.**
		1		Apply the design process, including understanding customer needs, interpreting and producing design constraints and criteria, planning and requirements analysis, brainstorming and idea generation, using appropriate modeling and prototyping, testing, verification, and implementation.
		2		Demonstrate the ability to evaluate a design or product and improve the design using testing, modeling, and research.
		3		Demonstrate the ability to record and organize information and test data during design evaluation.