

15.0000 Engineering, General (2011)

Knowledge	Skills	Performance Element	
			Technical Standards - Michigan Customized List
I			Engineering Design
	B		Design Process/Problem Solving
		1	Identify principles of the problem solving process
		2	Utilize the steps in a design process
		a	Product R&D
		b	Market/Sales/Life Cycle Analysis
		c	Intellectual Property Protection (e.g. patents, trademarks, copyrights, etc.)
		d	Design Management
		e	Simulation/Engineering Design Analysis
		f	Concurrent Engineering
		g	Design for X (Manufacturing/Assembly/Maintenance/etc.)
		h	Drafting/Drawing/Engineering Graphics/Modeling
		i	CAD/CAM/CAE Applications
		j	Tolerance Analysis/GD & T
		k	Product Liability
		3	Translate word problems into mathematical statements
		4	Analyze solutions, identifying strengths and weaknesses
		5	Develop details of a solution
		a	Identify design principles used to evaluate existing designs, to collect data, and to guide the design process.
		b	Describe the influence of personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly on the Engineering Design process.
		6	Develop, test, and redesign prototypes
		a	Construct a prototype or a working model used to test a design concept by making actual observations and necessary adjustments.
		b	Identify factors taken into account in the process of engineering.

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		7	Utilize a standardized troubleshooting methods for diagnosis
		a	Identify the problem or opportunity
		b	Identify possible solutions through problem solving skills
		c	Apply brainstorming techniques
		d	Collect and analyze data effectively
		e	Explain cause and effect relationships
		f	Select optimum specifications and create models & prototypes
		g	Test solutions in a controlled environment
		h	Redesign based on the evaluation of the models & prototypes
		i	Implement and monitor for future improvements
		8	Identify common quality control methods
		9	Discuss quality and continuous improvement methods used in engineering
		a	Customer Focus (Research/Test/Satisfaction)
		b	Quality System and Standards (e.g. QS/ISO/CE/Mark/etc.)
		c	Probability and Statistics
		d	Statistical Control Methods (Sampling/Charting/etc.)
		e	Problem Analysis & Solving (Fishbone/Pareto/FMEA/etc.)
		f	Factor Analysis (DOE/Correlation/etc.)
		g	Capability Analysis (Process/Equipment/etc.)
		h	Inspection/Test/Validation
		i	Metrology
		j	Reliability Analysis
		k	Continuous Improvement/Lean
		l	Customer and Field Service

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			Science, Technology, Engineering & Mathematics - Engineering and Technology Pathway
I			ACADEMIC FOUNDATIONS
	A		Apply the concepts and processes using the guiding principles and standards of school mathematics to solve STEM problems.
		1	Apply and create appropriate models, concepts, and processes for an assigned situation, and apply them in solving the problem.
		2	Explain the impact of assumptions, initial conditions, boundary conditions, and other constraints on problem solutions.
III			PROBLEM-SOLVING AND CRITICAL THINKING
	A		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

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	A		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.
XI			DESIGN
	A		Know the elements of the processes and concepts for understanding the design process.
		2	Explain the elements and steps of the design process and tools or techniques that can be used for each step.
	B		Develop processes and concepts to apply the design process.
		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.
Science, Technology, Engineering and Mathematics Cluster Foundation Standards			
III			PROBLEM-SOLVING AND CRITICAL THINKING: <i>Solve problems using critical thinking skills (analyze, synthesize, and evaluate) independently and in teams. Solve problems using creativity and innovation.</i>

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	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	Apply the skills and abilities in requirements analysis and configuration control while working plans, processes, and projects as assigned.
		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.
IV			INFORMATION TECHNOLOGY APPLICATIONS: <i>Use information technology tools specific to the career cluster to access, manage, integrate, and create information.</i>
	B		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.
		a	Use statistical tools to analyze data.
		b	Query and extract information from data.
		c	Create knowledge from data.
		4	Apply statistical tools that verify the reliability or validity of the data used or collected in the plan, project, process, or problem.
		a	Using a selected statistical tool, compute data reliability.
		b	Select and use the tools to analyze and synthesize data.
		c	Describe the meaning of probability and how it applies to a set of data.

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		5	Apply a technological, scientific, or mathematical concept (use of algorithms) when communicating with others on issues, plans, processes, problems, or concepts.
		a	Select the proper visualization tools.
		b	Use simulation, modeling, prototype techniques to solve problems.
		c	Communicate data visually.
Science, Technology, Engineering and Mathematics Cluster Essential Standards			
III			PROBLEM-SOLVING AND CRITICAL THINKING: <i>Solve problems using critical thinking skills (analyze, synthesize, and evaluate) independently and in teams. Solve problems using creativity and innovation.</i>
	A		Employ critical thinking skills independently and in teams to solve problems and make decisions (e.g., analyze, synthesize and evaluate).
		1	Identify common tasks that require employees to use problem-solving skills.
		2	Analyze elements of a problem to develop creative solutions.
		3	Describe the value of using problem-solving and critical thinking skills to improve a situation or process.
		4	Create ideas, proposals, and solutions to problems.
		5	Evaluate ideas, proposals, and solutions to problems.
		6	Use structured problem-solving methods when developing proposals and solutions.
		7	Generate new and creative ideas to solve problems by brainstorming possible solutions.
		8	Critically analyze information to determine value to the problem-solving task.
		9	Guide individuals through the process of recognizing concerns and making informed decisions.
		10	Identify alternatives using a variety of problem-solving and critical thinking skills.
		11	Evaluate alternatives using a variety of problem-solving and critical thinking skills.

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	D		Conduct technical research to gather information necessary for decision-making.
		1	Align the information gathered to the needs of the audience.
		2	Gather technical information and data using a variety of resources.
		3	Analyze information and data for value to the research objectives.
		4	Evaluate information and data to determine value to research objectives.
			MICHIGAN CAREER AND EMPLOYABILITY STANDARDS
I			APPLIED ACADEMIC SKILLS
	B		Mathematics
		1	Approach practical and workplace problems using a variety of mathematical techniques.
		2	Research how math is used in the workplace and make a presentation detailing the process.
IV			PROBLEM SOLVING
	A		Problem Solving
		1	Apply a problem solving model to a workplace situation that involves setting goals, implementing and evaluating results.
		2	Identify typical problems that occur in a workplace and use a problem solving model to devise solutions, compare alternatives to past solutions, and predict their success.
XI			MICHIGAN TECHNOLOGY STANDARDS
			Michigan Educational Technology Standards for Students (METS-S) 2009
	D		Critical Thinking, Problem Solving, and Decision Making - By the end of Grade 12 each student will:
		1	Use digital resources (e.g., educational software, simulations, models) for problem solving and independent learning

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		2		Analyze the capabilities and limitations of digital resources and evaluate their potential to address personal, social, lifelong learning, and career needs
		3		Devise a research question or hypothesis using information and communication technology resources, analyze the findings to make a decision based on the findings, and report the results
	F			Technology Operations and Concepts - By the end of Grade 12 each student will:
		7		Assess and solve hardware and software problems by using online help or other user documentation
		9		Participate in experiences associated with technology-related careers