Computer Integrated Manufacturing

Unit 1 Overview Computer

Michigan Grades 9-12 Math Strand/Standards Linked	Student will be able to demonstrate the ability to store, retrieve copy, and output drawing files depending upon syst	Students will be able to utilize instructor identified 2D computer sketching functions.	Students will be able to incorporate various coordinate systems in the construction of 2 D geometrical shapes.	Students will be able to calculate the x and y coordinates given a radius and angle.	Students will be able to produce 2D sketches using available sketching features.	Students will be able to apply editing techniques to produce accurate sketches.	Student will be able to understand and apply sketch constraints.	Students will analyze drawings with appropriate inquiry functions.	Students will be able to define sketched objects with dimensions and geometric constraints.	Students will be able to apply necessary sketched features to generate a solid model.	Students will be able to demonstrate the application and modifying of placed features.	Students will be able to develop multi-view drawings such as top, front, right side, isometric, section and auxiliary vi	Students will be able to demonstrate the proper application of annotations and reference dimensions while conform	Students will be able to update model and drawing views using revision specification sheets provided by the instruc	Students will be able to create assembly models through the integration of individual parts and sub-assemblies.	Students will be able to generate an assembly drawing, which include Views, Balloons, and Bill Of Materials (BOM)	Students will be able to recognize the wide array of industry-wide prototyping methods in use.	Students will identify the need for rapid-prototyping.	Students will prepare a prototype model from a drawing data base.
MATH GRADES 9-12: http://www.michigan.gov/mde/0,160 140-38924_41644_42668---,00.html		x	x	x	x		x	x	x	x	x	x	x	x	x	x	x		
STRAND 1: QUANTITATIVE LITERACY AND LOGIC											x								
STANDARD L2: CALCULATION, ALGORITHMS, AND ESTIMATION																			
STANDARD L3: MEASUREMENT AND PRECISION																			
QSMP3.1 Measurement Units, Calculations, and Scales																			
QSMP3.1.1 Convert units of measurement within and betwee systems; explain how arithmetic operations on meas units, and carry units through calculations c																			
QSMP3.2 Understanding Error																			
QSMP3.2.1 Determine what degree of accuracy is reasonable measurements in a given situation; express accuracy significant digits, error tolerance, or percen errors in measurements are magn accumulated error in app																			
STANDARD L4: MATHEMATICAL REASONING, LOGIC, AND PROOF											x								
QSMRLP4.1 Mathematical Reasoning											x								
QSMRLP4.1.3 Define and explain the roles of axioms (postula definitions, theorems, counterexamples, and proofs structure of mathematics; identify and gi											x								
STRAND 2: ALGEBRA AND FUNCTIONS							x	x					x	x	x	x	x		
STANDARD A2: FUNCTIONS							x						x						
AFF2.2 Operations and Transformations																			
AFF2.2.2 Apply given transformations (e.g., vertical or horiz shifts, stretching or shrinking, or reflections about to basic functions, and represent symboli																			
AFF2.5 Exponential and Logarithmic Functions							x												
AFF2.5.1 Write the symbolic form and sketch the graph of a exponential function given appropriate information. (value of 4 and a rate of growth of 1.5, v							x												
AFF2.6 Quadratic Functions							x						x						
AFF2.6.1 Write the symbolic form and sketch the graph of a function given appropriate information (e.g., vertex							x						x						
AFF2.6.2 Identify the elements of a parabola (vertex, axis of symmetry, direction of opening) given its symbolic f and relate these elements to the coefficie of the function.																			
AFF2.7 Power Functions (including roots, cubics, quartics, etc.)							x						x						
AFF2.7.1 Write the symbolic form and sketch the graph of p functions.							x						x						
AFF2.8 Polynomial Functions							x						x						
AFF2.8.1 Write the symbolic form and sketch the graph of si polynomial functions.							x						x						
AFF2.9 Rational Functions													x						
AFF2.9.1 Write the symbolic form and sketch the graph of si rational functions.							x						x						
STANDARD A3: MATHEMATICAL MODELING								x						x	x	x	x		
AFMM3.1 Models of Real-world Situations Using Families of Functions.								x						x	x	x	x		
AFMM3.1.1 Identify the family of function best suited for mo given real-world situation (e.g., quadratic functions object under the force of gravity; expon interest; trigonometric functi example above, rec exponenti															x	x	x		
AFMM3.1.2 Adapt the general symbolic form of a function to fits the specifications of a given situation by using replace arbitrary constants with numbe substitute the given values P0 300(1.02)t.														x					
AFMM3.1.3 Using the adapted general symbolic form, draw reasonable conclusions about the situation being mo example above, the exact solution is 365.(appropriate approximation is 36								x											
STRAND 3: GEOMETRY AND TRIGONOMETRY		x	x	x	x		x		x	x		x							
STANDARD G1: FIGURES AND THEIR PROPERTIES			x	x					x			x							
GTFP1.1 Lines and Angles; Basic Euclidean and Coordinate Geometry				x															
GTFP1.1.1 Solve multi-step problems and construct proofs ir vertical angles, linear pairs of angles supplementary complementary angles, and right angles.				x															
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GTFP1.1.3 Perform and justify constructions, including midpo line segment and bisector of an angle, using straigh compass.				x															
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GTFP1.1.6 Recognize Euclidean Geometry as an axiom syster the key axioms and understand the meaning of and between undefined terms (e.g., point, line, and theorems.																			
GTFP1.2 Triangles and Their Properties												x							
GTFP1.2.1 Prove that the angle sum of a triangle is 180° and exterior angle of a triangle is the sum of the two re angles.												x							
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STANDARD G2: RELATIONSHIPS BETWEEN FIGURES		x	x		x		x			x			x						
GTRF2.2 Relationships Between Two-dimensional and Three-dimensional Representations		x			x		x			x			x						
GTRF2.2.1 Identify or sketch a possible 3-dimensional figure, dimensional views (e.g., nets, multiple views); crea representation of a 3-dimensional figure.		x			x		x						x						
GTRF2.2.2 Identify or sketch cross-sections of 3-dimensional identify or sketch solids formed by revolving 2-dime around lines.		x					x			x			x						
GTRF2.3 Congruence and Similarity			x																
GTRF2.3.2 Use theorems about congruent triangles to prove theorems and solve problems, with and without us			x																
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SPSSE3.1 Data Collection and Analysis								x											
SPSSE3.1.3 Distinguish between an observational study and experimental study, and identify, in context, the co be drawn from each.								x											

Unit 2 Programmable Machining

Michigan Grades 9-12 Math Strand/Standards Linked	Students will be able to explain the history of Computer Controlled Machines charting the growth of NC and how it	Students will be able to explain how the application of CNC machines has impacted manufacturing.	Students will be able to explain the advantages and disadvantages of CNC Machining.	Students will be able to chart the evolution of machine tools, controllers, and software used in programmable mach	Students will explore career opportunities and educational requirements within the field of programmable machines	Students will identify the axis relative to various CNC machines.	Students will contrast open and closed loop control systems.	Students will identify the types of drive systems used in CNC machines.	Students will be able to use the CNC control program to indicate the machine position and then contrast that positio	Students will be able to identify and explain the function of the major components of a CNC machine tool.	Students will examine and apply various work holding devices commonly used for CNC machining.	Students will identify various types of tool changers used in CNC machine tools.	Students will define the three primary axes used in CNC machining and explore the remaining axes used in advanc	Students will explain the importance of cutting tool materials and how they affect the speed and feed rates used by	Students will examine different types of tool holding devices used in CNC machine tools.	Students will be able to select appropriate cutting tools to efficiently, safely and accurately cut parts using a CNC m	Students will understand the difference between reference and position points.	Students will understand that CNC machine movements are identified by axes.	Students will understand that the axis system is a worldwide standard for machine movement.	Students will be able to plot points using absolute, relative (incremental) and polar coordinates.	Students will be able to identify Significant Points on geometric shapes (ex. Center point, end point).	Students will be able to identify the optimum location for the Program Reference Zero (PRZ) point.	Students will be able to identify the three categories of machine movement: straight line, curved line, and non-regul	Students will be able to complete a preliminary planning sheet to identify necessary work holding devices, cutting to	Students will be able to define the term "Alphanumeric Coding."	Students will be able to define the term "G codes."	Students will be able to define the term "M code."	Students will be able to identify the three sections of a program; Initial Commands, Program Body, and Program En	Students will be able to write a basic NC part program using necessary G and M codes including remarks that desc	Students will be able to explore the advantages and disadvantages of shop floor programming as well as off line pr	Students will be able to create a simple NC part program using a text editor and a CAM package.	Students will be able to employ a CAD/CAM/CNC software solution to create a part.	Students will be able to analyze, identify and correct errors found in NC part program files.	Students will be able to use simulation software to graphically verify NC program operation.	Students will be able to perform a "Dry Run" to verify the machine setup and program operation.	Student will be able to demonstrate the ability to safely setup, maintain and operate a CNC machine center using a	Students will be able to analyze part geometry to select appropriate cutting tools and fixturing devices needed to cr	Students will be able to setup and edit the tool library of a CNC control program providing offset values and tool geo	Students will be able to calculate and verify appropriate spindle speeds and feed rates specific to each cutting tool	Students will be able to safely and accurately fixture a part in a CNC machine and set the program reference zero (	Students will be able to verify NC part programs using a simulation software before machining the part on a CNC d	Students will be able to list and demonstrate all possible methods of disabling a CNC machine in the event of an er	Students will follow a safety checklist prior to running an NC part program on a CNC machine. See Safety Checklis	Students will be able to Perform a Dry Run to verify the machine setup and program operation.	Students will be able to operate a CNC machine to cut a part to specifications.	Students will be able to measure using standard and metric systems.	Students will be able to convert measurements between metric and standard inch systems.	Students will be able to read technical drawings identifying and understand the dimensional tolerances and limits.	Students will be able to make precision measurements to the degree of accuracy required by plan specification usi	Students will understand how comparison instruments can be used to check dimensions, compare shapes, indicate	Students will be aware of advanced and automated measurement systems that are applied in industry. (ex. Coordir	Students will be aware of the importance of precision measurement in SPC and quality control.	Students will be able to define the acronym CAM and explain what the purpose of a CAM package is.	Students will demonstrate their ability to operate the user interface of a CAM package and access help using appro	Students will be able to perform basic file operations using a CAM package such as saving, opening, printing and e	Students will demonstrate an ability to import and export CAD files using a CAM package.	Students will setup a CAM package by editing the material and tool libraries, defining stock sizes, selecting the app	Students will define and apply the fundamental and advanced milling and turning procedures used in CAM package	Students will use a CAM package to generate and edit tool paths by applying appropriate machining processes to g
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Unit 3 Introduction To Robotics

Michigan Grades 9-12 Math Strand/Standards Linked	Students will explore the chronological development of automation leading to robotics.	Students will investigate career opportunities in the robotics career fields.	Students will demonstrate the development of robotics from Science Fiction.	Students will identify a minimum of four dangerous and repetitive jobs that robots are used for.	Students will formulate a definition of a robot.	Students will be able to classify different types of Robots.	Students will evaluate the positive impact robots have on manufacturing.	Students will discuss the social implications of robots.	Students will identify and compare the four classifications of robots.	Students will investigate a classification of robot.	Students will design and build a working model of a robot.	Students will identify and report specifications and work envelopes of robots.	Students will identify and sketch the mechanical components to a robot.	Students will design and develop an end effector.	Students will demonstrate their understanding of the way end effectors are specific to a process.	Students will understand the various drive systems used in robotics and analyze the advantages and disadvantage	Students will understand the basic components of robot controllers.	Students will demonstrate an understanding of control techniques and computer simulations.	Students will design and build a feed system with sensors.	Students will program a robot to perform several tasks.	Students will program a robot to solve a materials handling problem.	Students will recognize the need for end of arm tooling and how this tooling affects the robots operation.	Students will understand the necessity for specialty tooling applications in robotics.	Students will prepare and document a presentation on end of arm tooling.	Students will analyze and generate the solution to a robotic manufacturing problem
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Unit 4 Computer Integrated Manufacturing

Michigan Grades 9-12 Math Strand/Standards Linked	Students will understand how the individual components of a flexible manufacturing system are interrelated.	Students will recognize the benefits and problems associated with CIM technology and how they affect the manufa	Students will identify some basic characteristics of a manufacturing operation that lend themselves to computer inte	Students will identify some of the typical components and sub systems that make up an automated machining, ass	Student will identify the three categories of CIM manufacturing systems.	Students will compare and contrast the benefits and drawbacks of the three categories of CIM manufacturing syste	Students will compare and contrast the benefits and drawbacks of the three categories of CIM manufacturing syste	The students will be able to identify the components of a FMS.	Students will identify and study the relationship between a CNC milling machine interface and a jointed arm robot i	Students will explore the individual components used in selected CIM systems.	Students will analyze and select components for a CIM system for a specific industrial application.	Students will understand the various applications of a Programmable Logic Controller as related to its use in a CIM	Students will understand the difference between a PLC and a computer with interface.	Students will recognize and understand the necessary safety precautions associated with a fully automated CIM sy	Students will recognize and explain the significance of teamwork and communication when they combine the desig	Students will demonstrate how their individual components work together to form a complete CIM system.	Students will assemble and test their individual component designs by integrating them into a complete miniature F
MATH GRADES 9-12: http://www.michigan.gov/mde/0,160 140-38924_41644_42668---,00.html																	
STRAND 1: QUANTITATIVE LITERACY AND LOGIC																	
STANDARD L2: CALCULATION, ALGORITHMS, AND ESTIMATION																	
STANDARD L3: MEASUREMENT AND PRECISION																	
QSMP3.1 Measurement Units, Calculations, and Scales																	
QSMP3.1.1 Convert units of measurement within and betwee systems; explain how arithmetic operations on meas units, and carry units through calculations c																	
QSMP3.2 Understanding Error																	
QSMP3.2.1 Determine what degree of accuracy is reasonable measurements in a given situation; express accuracy significant digits, error tolerance, or percen errors in measurements are magn accumulated error in app																	
STANDARD L4: MATHEMATICAL REASONING, LOGIC, AND PROOF																	
QSMRLP4.1 Mathematical Reasoning																	
QSMRLP4.1.3 Define and explain the roles of axioms (postula definitions, theorems, counterexamples, and proofs structure of mathematics; identify and gi																	
STRAND 2: ALGEBRA AND FUNCTIONS																	
STANDARD A2: FUNCTIONS																	
AFF2.2 Operations and Transformations																	
AFF2.2.2 Apply given transformations (e.g., vertical or horiz shifts, stretching or shrinking, or reflections about to basic functions, and represent symboli																	
AFF2.5 Exponential and Logarithmic Functions																	
AFF2.5.1 Write the symbolic form and sketch the graph of a exponential function given appropriate information. (value of 4 and a rate of growth of 1.5, v																	
AFF2.6 Quadratic Functions																	
AFF2.6.1 Write the symbolic form and sketch the graph of a function given appropriate information (e.g., vertex																	
AFF2.6.2 Identify the elements of a parabola (vertex, axis of symmetry, direction of opening) given its symbolic f and relate these elements to the coefficie of the function.																	
AFF2.7 Power Functions (including roots, cubics, quartics, etc.)																	
AFF2.7.1 Write the symbolic form and sketch the graph of p functions.																	
AFF2.8 Polynomial Functions																	
AFF2.8.1 Write the symbolic form and sketch the graph of si polynomial functions.																	
AFF2.9 Rational Functions																	
AFF2.9.1 Write the symbolic form and sketch the graph of si rational functions.																	
STANDARD A3: MATHEMATICAL MODELING																	
AFMM3.1 Models of Real-world Situations Using Families of Functions.																	
AFMM3.1.1 Identify the family of function best suited for mo given real-world situation (e.g., quadratic functions object under the force of gravity; expon interest; trigonometric functi example above, rec exponenti																	
AFMM3.1.2 Adapt the general symbolic form of a function to fits the specifications of a given situation by using replace arbitrary constants with numbe substitute the given values P0 300(1.02)t.																	
AFMM3.1.3 Using the adapted general symbolic form, draw reasonable conclusions about the situation being mo example above, the exact solution is 365.(appropriate approximation is 36																	
STRAND 3: GEOMETRY AND TRIGONOMETRY																	
STANDARD G1: FIGURES AND THEIR PROPERTIES																	
GTFP1.1 Lines and Angles; Basic Euclidean and Coordinate Geometry																	
GTFP1.1.1 Solve multi-step problems and construct proofs ir vertical angles, linear pairs of angles supplementary complementary angles, and right angles.																	
GTFP1.1.2 Solve multi-step problems and construct proofs ir corresponding angles, alternate interior angles, alte angles, and same-side (consecutive) inte																	
GTFP1.1.3 Perform and justify constructions, including midpo line segment and bisector of an angle, using straigh compass.																	
GTFP1.1.4 Given a line and a point, construct a line through t that is parallel to the original line using straighted a line and a point, construct a line thr perpendicular to the origina																	
GTFP1.1.5 Given a line segment in terms of its endpoints in t coordinate plane, determine its length and midpoint																	
GTFP1.1.6 Recognize Euclidean Geometry as an axiom syster the key axioms and understand the meaning of and between undefined terms (e.g., point, line, and theorems.																	
GTFP1.2 Triangles and Their Properties																	
GTFP1.2.1 Prove that the angle sum of a triangle is 180° and exterior angle of a triangle is the sum of the two re angles.																	
GTFP1.2.2 Construct and justify arguments and solve multi-s problems involving angle measure, side length, perim all types of triangles.																	
GTFP1.4 Quadrilaterals and Their Properties																	
GTFP1.4.2 Solve multi-step problems and construct proofs ir quadrilaterals (e.g., prove that the diagonals of a rh perpendicular) using Euclidean methods o																	
GTFP1.6.2 Solve problems and justify arguments about chor a line through the center of a circle is perpendicula bisects the chord) and lines tangent to c circle is perpendicular to the																	
GTFP1.7 Conic Sections and Their Properties																	
GTFP1.7.2 Identify and distinguish among geometric represe of parabolas, circles, ellipses, and hyperbolas; descr symmetries, and explain how they are rela																	
STANDARD G2: RELATIONSHIPS BETWEEN FIGURES																	
GTRF2.2 Relationships Between Two-dimensional and Three-dimensional Representations																	
GTRF2.2.1 Identify or sketch a possible 3-dimensional figure, dimensional views (e.g., nets, multiple views); crea representation of a 3-dimensional figure.																	
GTRF2.2.2 Identify or sketch cross-sections of 3-dimensional identify or sketch solids formed by revolving 2-dime around lines.																	
GTRF2.3 Congruence and Similarity																	
GTRF2.3.2 Use theorems about congruent triangles to prove theorems and solve problems, with and without us																	
GTRF2.3.4 Use theorems about similar triangles to solve prol with and without use of coordinates.																	
STRAND 4: STATISTICS AND PROBABILITY																	
STANDARD S1: UNIVARIATE DATA - EXAMINING DISTRIBUTIONS																	
SPUD1.2.2 Estimate the position of the mean, median, and m both symmetrical and skewed distributions, and fro distribution or histogram.																	
STANDARD S3: SAMPLES, SURVEYS, AND EXPERIMENTS																	
SPSSE3.1 Data Collection and Analysis																	
SPSSE3.1.3 Distinguish between an observational study and experimental study, and identify, in context, the co be drawn from each.																	