LOS MEDANOS COLLEGE

ARTICULATION AGREEMENT

DATE DRAFTED: January 27, 2020
VALID ACADEMIC YEAR: 2019-20 & 2020-21

LMC COURSE: ENGIN-025 Engineering Graphics

HIGH SCHOOL COURSE: Introduction to Engineering Design

School: Pittsburg High School
Address: 1750 Harbor St., Pittsburg, CA 94565

COLLEGE COURSE DESCRIPTION: This course introduces descriptive geometry and engineering graphics techniques. Techniques include freehand and instrument drawing, while the primary emphasis is on computer aided drafting. Applications of descriptive geometry include orthographic drawings, sectional views, and auxiliary views. Axonometric, oblique, and perspective drawings are also covered. Other topics include revolutions, tolerances, dimensions, fasteners, springs, detail drawings, and assembly drawings.

A. **UNITS: 3**
B. **PRE-REQUISITES: NA**
C. **REQUIRED CONTENT FOR ARTICULATION:**

Unit 1: Design Process
Lesson 1.1: Introduction to a Design Process
1. There are many design processes that guide professionals in developing solutions to problems.
2. A design process most used by engineers includes defining a problem, brainstorming, researching, identifying requirements, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype, testing, refining, making, and communicating results.
3. Design teams use brainstorming techniques to generate large numbers of ideas in short time periods.
4. Engineers conduct research to develop their knowledge base, stimulate creative ideas, and make informed decisions.
5. A designer uses an engineer's notebook to chronologically document all aspects of a design project.

Lesson 1.2: Introduction to Technical Sketching and Drawing
1. Engineers create sketches to quickly record, communicate, and investigate ideas.
2. Pictorials and tonal shading techniques are used in combination to give sketched objects a realistic look.
3. Designers use isometric, oblique, perspective, and multiview sketching to maintain an object's visual proportions.
4. A multiview projection is the most common method of communicating the shape and size of an object that is intended for manufacture.

Lesson 1.3: Measurement and Statistics
1. Measurement systems were developed out of the need for standardization.
2. Engineers apply dimensions to drawings to communicate size information.
3. Manufactured parts are often created in different countries, where dimensional values are often converted from one standard unit to another.

4. The amount of variation that can be measured depends on the precision of the measuring tool.
5. Statistical analysis of measurements can help to verify the quality of a design or process.
6. Engineers use graphics to communicate patterns in recorded data.

Lesson 1.4: Puzzle Cube

1. Three-dimensional forms are derived from two-dimensional shapes.
2. The results of the design process are commonly displayed as a physical model.
3. Engineers develop models to communicate and evaluate possible solutions.
4. Geometric and numeric constraints are used to define the shape and size of objects in Computer Aided Design (CAD) modeling systems.
5. Engineers use CAD modeling systems to quickly generate and annotate working drawings.
6. Packaging not only protects a product, but contributes to that product's commercial success.

Unit 2: Design Exercises

Lesson 2.1: Geometric Shapes and Solids

1. Geometric shapes describe the two or three dimensional contours that characterize an object.
2. The properties of volume and surface area are common to all designed objects and provide useful information to the engineer.
3. CAD systems are used to increase productivity and reduce design costs.
4. Solid CAD models are the result of both additive and subtractive processes.

Lesson 2.2: Dimensions and Tolerances

1. Working drawings should contain only the dimensions that are necessary to build and inspect an object.
2. Object features require specialized dimensions and symbols to communicate technical information, such as size.
3. There is always a degree of variation between the actual manufactured object and its dimensioned drawing.
4. Engineers specify tolerances to indicate the amount of dimensional variation that may occur without adversely affecting an object's function.
5. Tolerances for mating part features are determined by the type of fit.

Lesson 2.3: Advanced Modeling Skills

1. Solid modeling programs allow the designer to create quality designs for production in far less time than traditional design methods.
2. Engineers use CAD models, assemblies, and animations to check for design problems, verify the functional qualities of a design, and communicate information to other professionals and clients.
3. Auxiliary views allow the engineer to communicate information about an object's inclined surfaces that appear foreshortened in basic multiview drawings.
4. Designers use sectional views to communicate an object's interior features that may be difficult to visualize from the outside.
5. As individual objects are assembled together, their degrees of freedom are systematically removed.
6. Engineers create mathematical formulas to establish geometric and functional relationships within their designs.
7. A title block provides the engineer and manufacturer with important information about an object and its creator.
8. A parts list and balloons are used to identify individual components in an assembly drawing.
9. CAD programs allow to add materials to a model and calculate properties such as mass, density, and volume, based on the model geometry and material properties.

Lesson 2.4: Advanced Designs

1. Design solutions can be created as an individual or in teams.
2. Engineers use design briefs to explain the problem, identify solution expectations, and establish project constraints.
3. Teamwork requires constant communication to achieve the goal at hand.
4. Engineers conduct research to develop their knowledge base, stimulate creative ideas, and make informed decisions.
5. Engineers use a design process to create solutions to existing problems.
6. Engineers use CAD modeling systems to quickly generate and annotate working drawings.
7. Fluid Power Concepts could be used to enhance design solutions.

Unit 3: Reverse Engineering

Lesson 3.1: Visual Analysis

1. Visual design principles and elements constitute an aesthetic vocabulary that is used to describe any object independent of its formal title, structural, and functional qualities.
2. Tangible design elements are manipulated according to conceptual design principles.
3. Aesthetic appeal results from the interplay between design principles and elements.
4. Though distinctly different, a design's visual characteristics are influenced by its structural and functional requirements.
5. Visual appeal influences a design's commercial success.
6. Graphic designers are concerned with developing visual messages that make people in a target audience respond in a predictable and favorable manner.

Lesson 3.2: Functional Analysis

1. Mechanisms use simple machines to move loads through the input of applied effort forces.
2. Engineers perform reverse engineering on products to study their visual, functional, and structural qualities.
3. Through observation and analysis, a product's function can be divided into a sequence of operations.
4. Products operate as systems, with identifiable inputs and outputs.

Lesson 3.3: Structural Analysis

1. Objects are held together by means of joinery, fasteners, or adhesives.
2. Precision measurement tools and techniques are used to accurately record an object's geometry.
3. Operational conditions, material properties, and manufacturing methods help engineers determine the material makeup of a design.
4. Engineers use reference sources and computer-aided design (CAD) systems to calculate the mass properties of designed objects.

Lesson 3.4: Product Improvement By Design

1. Engineers analyze designs to identify shortcomings and opportunities for innovation.
2. Design teams use brainstorming techniques to generate large numbers of ideas in short time periods.
3. Engineers use decision matrices to help make design decisions that are based on analysis and logic.
4. Engineers spend a great deal of time writing technical reports to explain project information to various audiences.

Unit 4: Open-Ended Design Problems

Lesson 4.1: Engineering Design Ethics

1. The material of a product, how the material is prepared for use, its durability, and ease of recycling all impact a product's design, marketability, and life expectancy.
2. All products made, regardless of material type, may have both positive and negative impacts.

3. In addition to economics and resources, manufacturers must consider human and global impacts of various manufacturing process options.
4. Laws and guidelines have been established to protect humans and the global environment.
5. A conscious effort by product designers and engineers to investigate the recyclable uses of materials will play a vital role in the future of landfills and the environment.

Lesson 4.2: Design Teams:

1. Teams of people can accomplish more than one individual working alone.
2. Design teams establish group norms through brainstorming and consensus to regulate proper and acceptable behavior by and between team members.
3. Engineers develop Gantt charts to plan, manage, and control a design team's actions on projects that have definite beginning and end dates.
4. Virtual teams rely on communications other than face-to-face contact to work effectively to solve problems.
5. Each team member's strengths are a support mechanism for the other team members' weaknesses.
6. Conflict between team members is a normal occurrence, and can be addressed using formal conflict resolution strategies.

D. REQUIRED COMPETENCIES (PERFORMANCE OBJECTIVES) FOR ARTICULATION

Students will:

1) understand the value of an engineering journal and will maintain one for the duration of the course

2) understand and use a design process to take ideas from concept to prototype

3) be able to use Autodesk Inventor to create 3D models, assemblies, orthographic drawings, section views, detail views, & auxiliary views, including appropriate dimensions, scales, & notes.

E. METHODS FOR END OF COURSE ASSESSMENT:

1) Students must receive a 5 or higher on the PLTW End of Course Exam and pass the ACU Inventor Exam. Course grades in Introduction to Design are on the following scale: A=90%+, B=80%+, C=70%+, D=60%+. Grading: 70% Projects, Quizzes, Exams 30% daily classwork.

F. PROCEDURES AND/OR CRITERIA FOR COURSE ARTICULATION:

a. Complete the Introduction to Engineering Design course at Pittsburg high school with a grade of "B" or better.
b. Receive a "B" or better on the agreed upon college/high school final exam procedure.
c. Be recommended for credit by your high school teacher.
d. Apply for admission at Los Medanos College.
e. Register for CATEMA for electronic submission of college credit **OR** obtain copy of high school transcript and articulation agreement and submit to the LMC Office of Admissions & Records **within the academic year in which credit was earned.**
f. Upon completion of the above, the student will receive on his/her LMC and CCCCD (California Community College District) transcripts the units of credit for LMC's ENGIN-025 course.
g. College transcripts will reflect the **FINAL EXAM GRADE** earned and will be notated as *Credit by Exam.

G. TEXTBOOKS OR OTHER SUPPORTING MATERIALS

- Students will learn to keep an Engineering journal, and will use Autodesk Inventor for 3D modelling. Students will use a variety of digital sources to enhance learning, including but not limited to: Autodesk Tutorials, YouTube, and Design Websites.

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COLLEGE SIGNATURES

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Kevin Horan Date
LMC Vice President of Instruction & Student Services

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Ryan Pedersen Date
LMC Interim Dean of Mathematics & Physical Sciences

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Dennis Gravert Date
LMC Physical Sciences Department Chair

____
Francesca Briggs Date
LMC Engineering Faculty

HIGH SCHOOL/ROP/DISTRICT SIGNATURES

____
Todd Whitmire Date
Principal, Pittsburg High School

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Janet Schulze Date
Superintendent, Pittsburg Unified School District

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Jack Gillespie Date
Teacher, Pittsburg High School

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Beth Traub Date
Teacher, Pittsburg High School

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Kurt Osmer Date
Teacher, Pittsburg High School

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Brian Schick Date
Teacher, Pittsburg High School