Glendale Unified School District

High School

January 14, 2020

Department:	Career Technical Education
Course Title:	Robotics 1-2: Introduction to Engineering & Manufacturing
Course Code:	5467V/5468V
Grade Level(s):	9-12
School(s) Course Offered:	Glendale High School
UC/CSU Approved (Y/N, Subject):	Y; Visual & Performing Arts (F) / Interdisciplinary Arts
Course Credits:	10
Length of Course:	Full Year
Recommended Prerequisite:	None
Recommended Textbook:	Print Reading for Industry, Walter C. Brown/Ryan K. Brown, 10th Edition/2011, ISBN#978-1-63126-051-3
Course Overview:	Robotics 1-2: Introductory course for the Manufacturing and Product Development Industry Pathway. In this course, students express themselves visually and showcase their creativity. Instruction is given in the following areas of engineering, elements of design, architectural history, technical sketching including orthographic projection, dimensioning, perspective drawing, 2 point perspective drawing, and hand drawn 2D and 3D representations. Students also explore green architecture, clean energy and computer aided design. Students experience architectural problems related to the vocational fields of industrial design, interior design and engineering, examine trade-related occupations; and global human impact. Through hands-on projects, students apply engineering standards while documenting their work and designs in an engineer's notebook. Students design solutions to solve proposed problems and communicate solutions to peers and members of the

professional community. Within the field of engineering, students are introduced to the engineering profession and a common approach to the solution of engineering problems, and engineering design process. The course will give students confidence in organizing ideas, communication methods, teamwork, and the ability to work ideas into new and useful creations. This course introduces Engineering and Design with the addition of supplemental units of instruction and projects that address California's Visual and Performing Arts content standards.

Course Content-First Semester

Unit 1: **Intro to Engineering** *(5 weeks)*

STANDARDS
Anchor Standard: 5.2
Pathway Standard: C1.0,C1.1
Common Core Standards: CCSS

Industry Profile, Types of Engineering, and History of Engineering

A. Civil, Structural, Electrical, Mechanical, Manufacturing, 3D-Prototyping are explored through function and methodology. Each branch of engineering has its own related field of math and order. Slideshows and movies relay historic engineering accomplishments, such as historical bridges like the Brooklyn Bridge and the Golden Gate Bridge, and their societal impact on transportation, and the movement of goods and services. Students engage in occupational research on an engineering field of their choice, and report to the class in a powerpoint and presentation.

B. Example Assignment: Students shall use the internet and other sources for research on a famous Engineer of a historical engineering work. Students write a two-page paper on a selected engineering topic, or create a 20 slide powerpoint presentation.

Example Assignment: Student teams creating Mars missions in the Marsbound activity will develop a science question that requires a technical design solution, and then they must design a solution. This means they will have to prioritize communication systems, computer systems, and scientific instrument packages while making trade-offs to remain within the limits of their mass, power and budget constraints. These are the same considerations made by teams at JPL developing actual missions to Mars.

Unit 2: **Foundational Mathematics** *(2 weeks)*

STANDARDS
Anchor Standard: 5.1, 5.2,
Pathway Standard: B3.3, B7.4
Common Core Standards: CCSS

A. The foundational mathematics unit includes numerous lessons and exercises on mathematical concepts and techniques necessary for performing measurements and estimations and for performing calculations in a manufacturing environment in general. Students then practice performing arithmetic operations on fractional numbers. Although students have already learned these low level skills prior math classes, the review reinforces a strong understanding and builds student confidence to a point where these simple mathematical operations can be applied quickly and mentally in a manufacturing environment, without the need to refer to a textbook or notes. After learning fractions, the students learn how to perform conversion for angle measures between angles expressed in decimal degrees and angles expressed as degree, minute, second measures. Finally, students lead and practice conversion between distance measurements in the inch and metric systems.

B. Example Assignment: Students are frequently presented with quizzes and test questions. The questions are typically true/false. Multiple choice, or multiple selection in nature often include written questions as well as visual diagrams.

Unit 3: **Precision Measurements** *(5 weeks)*

STANDARDS
Anchor Standard: 5.3, 5.4, 7.4, 8.3
Pathway Standard: B1.2, B1.3, B1.4
Common Core Standards: CCSS

A. The precision measurements unit includes instructional lesson and hands-on practice on the three primary types of measuring instruments used in the manufacturing of fabricated metal products: the steel rule, the slide caliper, and the micrometer. The selection of measuring device based upon the degree of precision needed is discussed. The unit begins with the instruction on proper case, handling, cleaning, and storage of measuring instruments. Students then learn how to accurately measure using steel rules with various styles of graduations down to one hundredth of a inch on the decimal scale, and to one sixty fourth of an inch on a fractional scale.

Additionally, metric steel rules are covered and students practice making accurate measurements down to the nearest one millimeter. Students learn the difference between major and minor increments on the steel role and apply their knowledge of fractions from Unit 2 to performing simple addition and subtraction of minor increments to and from major increments while measuring. Students then learn and practice how to read the three types of slide calipers including vernier, dial, and digital types. Students learn how to read a fractional inch caliper to the nearest one-hundred-twenty-eighth of an inch and

how to read a decimal inch vernier caliper to the nearest one-thousandth of an inch. Finally, students learn how to read a metric vernier caliper to the nearest five hundredths of a millimeter. Students are then taught how to make internal, external, depth. Students learn how to verify the calibration of each type of micrometer and practice careful handling and operation while making precision measurements to the nearest five ten-thousandths of an inch.

Additionally, metric steel rules are covered and students practice making accurate measurements down to the nearest one millimeter. Students learn the difference between major and minor increments on the steel role and apply their knowledge of fractions from Unit 2 to performing simple addition and subtraction of minor increments to and from major increments while measuring. Students then learn and practice how to read the three types of slide calipers including vernier, dial, and digital types. Students learn how to read a fractional inch caliper to the nearest one-hundred-twenty-eighth of an inch and how to read a decimal inch vernier caliper to the nearest one-thousandth of an inch. Finally, students learn how to read a metric vernier caliper to the nearest five hundredths of a millimeter. Students are then taught how to make internal, external, depth. Students learn how to verify the calibration of each type of micrometer and practice careful handling and operation while making precision measurements to the nearest five ten-thousandths of an inch.

B. Example Assignment: Students are each given a unique machined component and are asked to perform various measurements such as length, thickness, and diameter on difference geometric features of the component. The measurements are performed will be transferred into a technical drawing. Not all surfaces will be measurable and the students must use math to problem solve the missing data. Students research advanced measurements methods.

Unit 4: **WorkShop Safety** *(3 weeks)*

STANDARDS
Anchor Standards: 6.2, 6.7
Pathway Standard: B7.1, B10.1
Common Core Standards: CCSS

A. Workshop Safety is a short entry level unit, and the concepts are always reviewed in each subsequent unit of study. In unit 4, students will participate in hands-on activities designed to build their foundational understanding of participation in a workshop classroom environment. Students will examine specific safety and use policies, procedures, and practices. Students will examine work spaces for safety and/or health concerns. They will be expected to demonstrate a variety of safety practices through various classroom assignments and activities and will demonstrate their understanding through completion of a required safety test. Many of the skills and procedures acquired in unit 1 will be built upon in subsequent units of study.

B. Example Assignment: Students will work in groups of 2-3 to create a poster diagramming and outlining key components of workshop safety. Students will present their posters to two other groups, and groups will evaluate one another's posters and presentation quality. They will write a 1-page reflection of the key safety features of the key equipment components in the course.

Example Assignment: Students will take a multiple choice safety test and pass the test with 90% accuracy prior to utilizing equipment and/or working in the shop area. All wrong questions will be written out with the correct answers, and will contain reasoning as to why the correct answer is appropriate.

Example Assignment: Students will develop a housekeeping/clean-up plan for each shop based on photographs and videos of the workshops as they appear during actual work. The plan will be in a spreadsheet format, identifying potential hazards and ways to mitigate those hazards so they do not result in injuries.

Example Assignment: Students will conduct a hands on performance assessment of the basic equipment.

Unit 5: **Basic Print Reading** *(10 weeks)*

STANDARDS
Anchor Standard: 2.3, 4.3
Pathway Standard: B1.1, B1.4,
Common Core Standards: CCSS

A. Beginning with Engineer's scales & paper & pencil, students will learn about the nature of technical drawings, and how everything is always drawn at a specific scale. Learning in both metric and imperial units, students will convert sizes of drawings accurately, and produce drawings at specific scales. Students will measure and calculate scale factors, and use drafting instruments to approximate sizes on drawings, for later input into CAD systems. Conversion of units will be addressed between imperial and metric units, as well as calculating between inches, feet, yards, etc. Students will measure machine parts and create accurate drawings in CAD based on real objects. Students will progress to CAD and create drawings at full scale in CAD, and learn how to control printing options to print out drawings at specific scales such as 1" = 1'-0", or 1/8" = 1'-0", or 1" = 100'.

B. Example Assignment: Students will create drawings on paper with an engineers scale at a specified scale that is of a different view and different from a scale of a drawing that is provided to them. The object may be provided in a 3D view, and students will need to generate top, right, and left views. This will teach both drawing to scale through the use of measuring instruments as well as cultivate 3D conceptual ability and exercise reasoning ability. CAD functions include User Interface, Draw & Modify commands, Measure and Scale commands, Text & Dimensions entry; Properties, Technical Drawing; Geometry review and properties of solids. Area and Volume calculations exercise students application of known math to applied problems.

Example Assignment: Presentation drawings: Students prepare Title Blocks format and edit text and size of graphics. Presentation drawings, one-point and two-point perspectives, client-ready drawings, for project progression.

Example Assignment: Machine & Mechanical Parts drawings in title blocks. Students exercise geometric perception and hand-drafting & CAD commands while producing drawings for machine parts with actual dimensions and text annotation.

Unit 6: **Intro to CAD** *(10 weeks)*

STANDARDS
Anchor Standard: 2.1, 2.5, 4.2
Pathway Standard: B10.3, D4.1
Common Core Standards: CCSS

A. In this unit students learn how to use Solidworks to create engineering drawings and designs. Students are given projects of various degrees of difficulty designed to reinforce the unit's content. The idea is that students learn best by doing. Students are shown how to set up a part document and how to use 2D-Sketch tools. 2D-Sketches are then used to generate 3D solid models. Included in this unit is over 50 projects using both inches and millimeters for students to use for practice in applying the various Sketch tools. Students will learn how to use the Features tools in Solidworks. Features tools are used to create and modify 3D solid models. Reference planes are covered and examples on how to edit existing models are also taught.

B. Students will use knowledge gained in Unit 5 to create and interpret orthographic views. Views are created using third angle projection in compliance to ANSI standards and conventions. Students will learn the differences between first-angle and third-angle projections. Also, students learn section views, auxiliary views, and broken views. Several projects require that a 3D solid model be brawn from a given set of orthographic views to help students develop. Visualization skills.

Unit 7: **Manufacturing as a Major and as a Career** *(5 weeks)*

STANDARDS
Anchor Standard: 3.4, 3.5, 3.6, 3.8
Pathway Standard: D1.0, D1.2, D2.2, D2.3
Common Core Standards: CCSS

A. In this unit, students come to realize that entering a career in manufacturing require highly skilled occupations that take place in very clean, high-tech environments and require a great variety of knowledge and skills to perform successfully. Students also realize that highly skilled individuals in the manufacturing industry can earn wages considerably high than in many other industries. Students conduct research on college

majors related to manufacturing as well as various types of manufacturing employers and occupations. They write up their findings and prepare and deliver a brief presentation.

B. Example Assignment: Students develop a personal resume indicating their skills and certifications gained through the class.

Example Assignment: Students gain valuable insight into manufacturing as a career through a field trip or a job shadow at a manufacturing facility. Students also interact with manufacturing professional who visit the class as guest speakers and prepare powerpoint presentation.

Course Materials

Manuals				
Title	Author	Publisher	Edition	Website
Machinery's Handbook	BY ERIK OBERG, FRANKLIN D. JONES, HOLBROOK L. HORTON, AND HENRY H. RYFFEL	Industrial Press New York	2008	BY ERIK OBERG, FRANKLIN D. JONES, HOLBROOK L. HORTON, AND HENRY H. RYFFEL

Websites				
Title	Author	Publisher	Edition	Website
Lynda	Gabriel Corbett	LinkedIn	N/A	https://www.lynda.com/
Immerse2learn	i2L	Immersive Engineering	N/A	http://web.immerse2learn.com/web/my-login/
OHSA	Various Contributors - US Department of Labor	US Department of Labor	N/A	https://www.osha.gov/

Other				
Title	Author	Publisher	Edition	Website
Solidworks	Solidworks	Dassault Systèmes	2017-2018	https://www.solidworks.com/