SECONDARY COURSE DESCRIPTION

SECTION A: COURSE CLASSIFICATION

ALAMEDA UNIFIED SCHOOL DISTRICT
Excellence & Equity For All Students

1. Course Title: **Engineering & Product Design 1**	6. Prerequisite(s): NA
2. Action: __x_ New Course ___ Course Revision ___ Title Change Only	7. Grade Level: 9 - 12
3. Transcript Title/Abbreviation: EnginProdDes 1 (For Educational Services)	8. Elective/Required: NA
4. Transcript Course Code/Course Number: RDII (For Educational Services)	9. Subject Area: CTE
5. CBEDS Code: 7110 (For Educational Services)	10. Department: CTE
11. Length /Credits: 10 ___ 0.5 (half year or semester equivalent) __x_ 1.0 (one year equivalent) ___ 2.0 (two year equivalent)	
12. Was this course previously approved by UC? ___ Yes _x__ No If so, year removed from list: _____	
13. Meets the "_____" requirements in the a-g university/college entrance requirement. Approval date: _____	
14. School Contact Information Name: ___Tracy Corbally_____ Title/Position: __Interim Principal_____ Phone: _____ Fax: _____ E-Mail: ___tcorbally@alamedaunified.org_____	

16. Signatures:

Department Chair: _____

Principal: Tracy Corbally
Tracy Corbally (Nov 20, 2020 17:08 PST)

Acknowledged by Other Principals: Robert Ithurburn
Robert Ithurburn (Nov 30, 2020 08:07 PST)

Doreen Bracamontes
Doreen Bracamontes (Nov 30, 2020 09:16 PST)

_____

Educational Services:
sstone@alamedaunified.org sstone@alamedaunified.org (Nov 30, 2020 09:21 PST)

16. BOE Approval

Signature of Superintendent:_____

Date of Approval_____

SECTION B. COURSE CONTENT

17. Course Description:

This course will introduce students to the complete engineering design cycle. Students will use computer-based two-dimensional and three-dimensional design software (*computers with preinstalled software will be provided to students*); students will learn through going through the actual product design and development process. With their completed product designs, students will manufacture their products using various digital manufacturing machines at the College of Alameda's FabLab (fabrication laboratory). (Note: the hands-on fabrication component will be done virtually during distance learning with students sending the files to the instructor who will record the process for the student to observe.) Students will produce materials for curricular support and manipulatives for Island High School classes and other schools. Machines used include: 3D printers, laser cutters, CNC routers, vinyl cutters. Emphasis will be on using design thinking and iterations when making products.

18. Course Goals and/or Major Student Outcomes:

The Engineering Design pathway provides learning opportunities for students interested in preparing for careers in the design and production of mechanical, electrical, and computer systems. The course offers hands-on learning that involves a deep understanding of how to measure, design, and produce products that can be manufactured in a FabLab.

Learning outcomes include:

1. Learn to design using 2D and 3D computer modeling programs.
2. Learn the pros and cons of various digital manufacturing machines.
3. Design and create useful products for daily use.
4. Use design thinking skills and iteration strategies

Students will also gain in-depth understanding of the following topics:

- Measurement and dimensions
- 2D vector design
- 3D modeling
- Product Design
- Digital Manufacturing
    - 3D Printing
    - Laser Cutting
    - Vinyl Cutting
    - CNC Routing
- Professional email communication
- Design Thinking

19. Course Objectives (standards below):

Students will:

1. Measure using fractions and decimals of the imperial measurement system.
2. Design using 2D software, such as Adobe Illustrator
3. Design using 3D software including Tinkercad and Fusion 360
4. Use the 3D printers
5. Use a laser cutter
6. Use a CNC router
7. Use a vinyl cutter
8. Produce their own products from their own designs

20. Course Outline:

Measurement, Safety and Product Design

Unit 1 Dimensions, Design, and Laser Cutting

A. Learn about measurements and dimensions

B. Design accurate ruler using 2D design software and the *parametric modeling* method

C. Rulers will be laser cut by students or staff, depending on COVID safety protocols

D. Discuss pro's and con's of laser cutting

Unit 2 X/Y (2D planes), Vinyl Cutting

A. Product design of "Vinyl Cut Name Decal" of their name

B. Design a sign with the name of the student

C. Student design is vinyl cut

D. Pro's and con's of vinyl cutting

Unit 3 2.5D/Laser Cutting

A. Students see step by step instructions to set up and use laser cutter

B. Safety Precautions

C. Students design and create a frame for their “Vinyl Cut Name Decal” using a laser cutter

Three-Dimensional Thinking

Unit 4 All about 3D Modeling and 3D printers

A. Design simple 3D model of a 3D cube using Tinkercad design software
B. How do 3D printers work and how to set up and use the 3D printer?
C. 3D print student designs
D. Pros and cons of 3D printing

Unit 5 3D product design- Making Math Manipulatives

A. Work with a “real life client” who will be an Island High school educator who needs support with a curricular issue that could be supported by materials.
B. Focus on digital communication with “Client”
C. Ideate project to be used in math classroom
D. Design product and produce using 3D printers or laser cutters.

Unit 6 3D Printing to Solve a Real Life Problem

A. Learn about 3D printer calibration and troubleshooting
B. Take and give feedback to improve project
C. Iterate product until it is completely functional as designed.

Programming a Computer Circuit

Unit 7. What is computer programming?

A. Physical Computing Game (via ZOOM)
B. Programming Robot Computer code game
C. Create simple circuit

Unit 8. Internet of Things

A. Discuss Smart Assistants and Internet of Things [IoT]

Unit 9. Design Thinking and Arduino Microcontrollers

A. Introduction to Design Thinking
B. Introduction to Arduino Microcontrollers
C. Computer programming

21. Instructional Materials:

- Board approved required text: Online resources will be used

- Supplementary materials: Computers with 2D and 3D design software will be provided; Aduino kits will be provided for the computer programming unit.

22. Instructional Methods and/or Strategies

Activity

- Observation and Demonstration
- Discussion
- Critique
- Projects/products
- Design/modeling software
- Manufacturing

23. Assessment and Evaluation

Products students produce will be assessed based on the individual student's growth and comprehension of the design thinking process. Students will complete the following products for the assessment:

1. Design and laser cut ruler
2. Design and vinyl cut name decal
3. Design and create picture frame on the laser cutter
4. Design 3D model of 3D cube
5. Emails to staff ("clients")
6. Final product completed using design thinking and communication skills

24. Grading Policy

Students will be graded based on their attendance and on project completion.

Course Standards

Engineering and Architecture Knowledge and Performance Anchor Standards

1.0 Academics

Analyze and apply appropriate academic standards required for successful industry sector pathway completion leading to postsecondary education and employment. Refer to the Engineering and Architecture academic alignment matrix for identification of standards.

2.0 Communications

Acquire and accurately use Engineering and Architecture sector terminology and protocols at the career and college readiness level for communicating effectively in oral, written, and multimedia formats. (Direct alignment with LS 9-10, 11-12.6)

2.1 Recognize the elements of communication using a sender–receiver model.

2.2 Identify barriers to accurate and appropriate communication.

2.3 Interpret verbal and nonverbal communications and respond appropriately.

2.4 Demonstrate elements of written and electronic communication, such as accurate spelling, grammar, and format.

2.5 Communicate information and ideas effectively to multiple audiences using a variety of media and formats.

2.6 Advocate and practice safe, legal, and responsible use of digital media information and communications technologies.

3.0 Career Planning and Management

Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans. (Direct alignment with SLS 11-12.2)

3.1 Identify personal interests, aptitudes, information, and skills necessary for informed career decision making.

3.2 Evaluate personal character traits, such as trust, respect, and responsibility, and understand the impact they can have on career success.

3.3 Explore how information and communication technologies are used in career planning and decision making.

3.4 Research the scope of career opportunities available and the requirements for education, training, certification, and licensure.

3.5 Integrate changing employment trends, societal needs, and economic conditions into career planning.

3.6 Recognize the role and function of professional organizations, industry associations, and organized labor in a productive society.

3.7 Recognize the importance of small business in California and global economies.

3.8 Understand how digital media are used by potential employers and postsecondary agencies to evaluate candidates.

3.9 Develop a career plan that reflects career interests, pathways, and postsecondary options.

4.0 Technology

Use existing and emerging technology to investigate, research, and produce products and services, including new information, as required in the Engineering and Architecture sector workplace environment. (Direct alignment with WS 11-12.6)

4.1 Use electronic reference materials to gather information and produce products and services.

4.2 Employ Web-based communications responsibly and effectively to explore complex systems and issues.

4.3 Use information and communication technologies to synthesize, summarize, compare, and contrast information from multiple sources.

4.4 Discern the quality and value of information collected using digital technologies, and recognize bias and intent of the associated sources.

4.5 Research past, present, and projected technological advances as they impact a particular pathway.

4.6 Assess the value of various information and communication technologies to interact with constituent populations as part of a search of the current literature or in relation to the information task.

5.0 Problem Solving and Critical Thinking

Conduct short as well as more sustained research to create alternative solutions to answer a question or solve a problem unique to the Arts, Media, and Entertainment sector, using critical and creative thinking, logical reasoning, analysis, inquiry, and problem-solving techniques. (Direct alignment with WS 11-12.7)

5.1 Identify and ask significant questions that clarify various points of view to solve problems.

5.2 Solve predictable and unpredictable work-related problems using various types of reasoning (inductive,
deductive) as appropriate.

5.3 Use systems thinking to analyze how various components interact with each other to produce outcomes in a
complex work environment.

5.4 Interpret information and draw conclusions, based on the best analysis, to make informed decisions.

6.0 Health and Safety

Demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the Engineering and Architecture sector workplace environment. (Direct alignment with RSTS 9-10, 11-12.4)

6.1 Locate, and adhere to, Material Safety Data Sheet (MSDS) instructions.

6.2 Interpret policies, procedures, and regulations for the workplace environment, including employer and employee responsibilities.

6.3 Use health and safety practices for storing, cleaning, and maintaining tools, equipment, and supplies.
6.4 Practice personal safety when lifting, bending, or moving equipment and supplies.
6.5 Demonstrate how to prevent and respond to work-related accidents or injuries; this includes demonstrating an understanding of ergonomics.
6.6 Maintain a safe and healthful working environment.
6.7 Be informed of laws/acts pertaining to the Occupational Safety and Health Administration (OSHA).

7.0 Responsibility and Flexibility

Initiate, and participate in, a range of collaborations demonstrating behaviors that reflect personal and professional responsibility, flexibility, and respect in the Engineering and Architecture sector workplace environment and community settings. (Direct alignment with SLS 9-10, 11-12.1)

7.1 Recognize how financial management impacts the economy, workforce, and community.
7.2 Explain the importance of accountability and responsibility in fulfilling personal, community, and workplace roles
7.3 Understand the need to adapt to changing and varied roles and responsibilities.
7.4 Practice time management and efficiency to fulfill responsibilities.
7.5 Apply high-quality techniques to product or presentation design and development.
7.6 Demonstrate knowledge and practice of responsible financial management.
7.7 Demonstrate the qualities and behaviors that constitute a positive and professional work demeanor, including
appropriate attire for the profession.
7.8 Explore issues of global significance and document the impact on the Arts, Media, and Entertainment sector.

8.0 Ethics and Legal Responsibilities

Practice professional, ethical, and legal behavior, responding thoughtfully to diverse perspectives and resolving contradictions when possible, consistent with applicable laws, regulations, and organizational norms. (Direct alignment with SLS 11-12.1d)

8.1 Access, analyze, and implement quality assurance standards of practice.
8.2 Identify local, district, state, and federal regulatory agencies, entities, laws, and regulations related to the Engineering and Architecture industry sector.
8.3 Demonstrate ethical and legal practices consistent with Engineering and Architecture sector workplace standards.
8.4 Explain the importance of personal integrity, confidentiality, and ethical behavior in the workplace.
8.5 Analyze organizational culture and practices within the workplace environment.
8.6 Adhere to copyright and intellectual property laws and regulations, and use and appropriately cite proprietary information.

8.7 Conform to rules and regulations regarding sharing of confidential information, as determined by Engineering and Architecture sector laws and practices.

9.0 Leadership and Teamwork

Work with peers to promote divergent and creative perspectives, effective leadership, group dynamics, team and individual decision making, benefits of workforce diversity, and conflict resolution as practiced in the SkillsUSA career technical student organizations. (Direct alignment with SLS 11-12.1b)

9.1 Define leadership and identify the responsibilities, competencies, and behaviors of successful leaders.

9.2 Identify the characteristics of successful teams, including leadership, cooperation, collaboration, and effective decision-making skills as applied in groups, teams, and career technical student organization activities.

9.3 Understand the characteristics and benefits of teamwork, leadership, and citizenship in the school, community, and workplace setting.

9.4 Explain how professional associations and organizations and associated leadership development and competitive career development activities enhance academic preparation, promote career choices, and contribute to employment opportunities.

9.5 Understand that the modern world is an international community and requires an expanded global view.

9.6 Respect individual and cultural differences and recognize the importance of diversity in the workplace.

9.7 Participate in interactive teamwork to solve real Engineering and Architecture sector issues and problems.

10.0 Technical Knowledge and Skills

Apply essential technical knowledge and skills common to all pathways in the Engineering and Architecture sector, following procedures when carrying out experiments or performing technical tasks. (Direct alignment with WS 11-12.6)

10.1 Interpret and explain terminology and practices specific to the Engineering and Architecture sector.

10.2 Comply with the rules, regulations, and expectations of all aspects of the Engineering and Architecture sector.

10.3 Construct projects and products specific to the Engineering and Architecture sector requirements and expectations.

10.4 Collaborate with industry experts for specific technical knowledge and skills.

11.0 Demonstration and Application

Demonstrate and apply the knowledge and skills contained in the Engineering and Architecture anchor standards, pathway standards, and performance indicators in classroom, laboratory and workplace settings, and through the SkillsUSA career technical student organization.

11.1 Utilize work-based/workplace learning experiences to demonstrate and expand upon knowledge and skills gained during classroom instruction and laboratory practices specific to the Engineering and Architecture sector program of study.

11.2 Demonstrate proficiency in a career technical pathway that leads to certification, licensure, and/or continued learning at the postsecondary level.

11.3 Demonstrate entrepreneurship skills and knowledge of self-employment options and innovative ventures.

11.4 Employ entrepreneurial practices and behaviors appropriate to Engineering and Architecture sector opportunities.

11.5 Create a portfolio, or similar collection of work, that offers evidence through assessment and evaluation of skills and knowledge competency as contained in the anchor standards, pathway standards, and performance indicators.

CTE Career Pathway Standards

Engineering Design Pathway

The Engineering Design pathway provides learning opportunities for students interested in preparing for careers in the design and production of mechanical, electrical, and computer systems.

Sample occupations associated with this pathway:

Mechanical/Electrical Drafter, Design Engineer, Manufacturing Design Engineer, Project Architect

C1.0 Understand historical and current events related to engineering design and their effects on society.

- C1.1 Know historical and current events that have relevance to engineering design.
- C1.2 Interpret the development of graphic language in relation to engineering design.

C2.0 Understand the effective use of engineering design equipment.

- C2.1 Employ engineering design equipment using the appropriate methods and techniques.
- C2.2 Apply conventional engineering design equipment procedures accurately, appropriately, and safely.
- C2.3 Apply the concepts of engineering design to the tools, equipment, projects, and procedures of the Engineering Design Pathway.

C3.0 Understand the sketching process used in concept development.

- C3.1 Apply sketching techniques to a variety of architectural models.
- C3.2 Produce proportional two- and three-dimensional sketches and designs.
- C3.3 Present conceptual ideas, analysis, and design concepts using freehand, graphic, communication techniques.

C4.0 Understand measurement systems as they apply to engineering design.

- C4.1 Know how the various measurement systems are used in engineering drawings.
- C4.2 Understand the degree of accuracy necessary for engineering design.

C5.0 Use proper projection techniques to develop orthographic drawings.

- C5.1 Understand the concepts and procedures necessary for producing drawings.
- C5.2 Develop multiview drawings using the orthographic projection process.
- C5.3 Understand the various techniques for viewing objects.
- C5.4 Use the concepts of geometric construction in the development of design drawings.
- C5.5 Apply pictorial drawings derived from orthographic multiview drawings and sketches.

C6.0 Understand the applications and functions of sectional views.

- C6.1 Understand the function of sectional views.
- C6.2 Clarify hidden features of an object using a sectional view and appropriate cutting planes.

C7.0 Understand the applications and functions of auxiliary views.

- C7.1 Understand the function of auxiliary views.
- C7.2 Use auxiliary views to clarify the true shape and size of an object.

C8.0 Understand and apply proper dimensioning standards to drawings.

- C8.1 Know a variety of drafting applications and understand the proper dimensioning standards for each.
- C8.2 Apply dimension to various objects and features.

C9.0 Understand the tolerance relationships between mating parts.

- C9.1 Understand what constitutes mating parts in engineering design.
- C9.2 Interpret geometric tolerancing symbols in a drawing.
- C9.3 Use tolerancing in an engineering drawing.

C10.0 Understand the methods of applying text to a drawing.

- C10.1 Describe the processes of lettering and/or text editing.
- C10.2 Implement standard methods of title block creation and use.
- C10.3 Develop drawings using notes and specifications. C10.4 Plan, prepare, and interpret drawings and models through traditional drafting or computer-aided design (CAD) techniques.

C11.0 Understand the methods of creating both written and digital portfolios.

- C11.1 Develop a binder or digital portfolio representative of completed work for presentation.
- C11.2 Give an effective oral presentation of a portfolio.