NAPA VALLEY
UNIFIED SCHOOL DISTRICT

High School Course of Study Approval Request Form

High School Site	Signature - Principal or Academic AP Designee	Signature - Teacher Leader (enter N/A if no Teacher Leader)	Comments:
American Canyon HS	Andrew Goff	Daniel Rosales	
Napa HS	Ean Ainsworth	Ron Solomon	
Napa Valley Independent Studies	Susan Wilson	NA	
New Tech HS	Riley Johnson	Kent McCarley	
Valley Oak HS	Maria Cisneros	NA	
Vintage HS	Katelyn Estudillo	Brady Mitchell	

Course submitted by:	Gillie Miller	School Site:	NCOE CTE Office

Executive Director, Secondary Education: _____

Review resources:
Rubric for Evaluating Digital Content & Technology Tools in Relation to CCSS for ELA (Grades 6-12)
State Math criteria
Technology in Teaching Math
Other criteria and decision making tools

Please review following high school course outline and sign above if you approve or write reason in comment area if you do not.

☐New **X Revised**

COMPUTER (Short) TITLE: P CTE Prin Engr
COURSE (Long) TITLE: P CTE Principles of Engineering & Robotics
AERIES TITLE: P CTE Principles Eng/Robotics
COURSE NUMBER: CTE558
GRADE LEVEL: 9 - 12
LENGTH OF COURSE: 1 year/10 credits (5 credits/semester)
GRAD REQUIREMENT: Elective (Z)
CSU/UC REQUIREMENT: "g" (College Preparatory Elective)
COLLEGE PREP: Yes
VOCATIONAL ED: Concentrator
CALPADS CODE: 7220
PATHWAY CODE: ENG 153
NCLB : No

COURSE OVERVIEW

COURSE DESCRIPTION

This engineering course provides a foundation in a wide range of engineering careers including digital design which can also be applied to careers in architecture, manufacturing, and construction. Students are introduced to production of mechanical, electrical, pneumatic, electronic, fluid, and electromechanical products and systems. This program integrates academic and technical preparation focusing on career exploration, knowledge and skill development. Topics covered include national and international drafting standards, drawing scales, orthographic projection, auxiliary views, sectioning, dimensioning, creation and modification of basic templates, and computer-aided drafting (CAD) using the latest version of Autodesk AutoCAD and Inventor software. Students will be designing parts using CAD; designing mechanical and electrical solutions, as well as constructing and assembling a variety of parts and prototypes. Students will be introduced to the world of automation by building and programming a simple robot that can complete a task repeatedly. The course covers the California CTE standards included in the Engineering Technology pathway under the Engineering and Architecture Industry Sector. The course is designed to prepare students for additional coursework in the pathway (Level 2) or lead to postsecondary technical training or education and entry to a rewarding career.

COURSE GOALS/OBJECTIVES

Gain a basic understanding of how products are designed and made.
Gain an understanding of the different careers related to Engineering, Manufacturing, and Architecture.
Obtain the skills needed for an Autodesk Certificate of Training
Ability to implement technical skills in the creation of working drawings, utilizing the latest release of the Autodesk AutoCAD and Inventor software.
Demonstrate real-world applications of core academic math and science.
Define what makes a safe workplace and cite common OSHA workplace standards.
Demonstrate engineering techniques and processes.
Explore the fundamentals of civil engineering.
Design and assemble wiring and pneumatic solutions for electrical and pneumatic powered assemblies.
Evaluate and integrate a variety of sensors into a project and be able write code to program and run a microcontroller.

COURSE CONTENT

Unit 1: Introduction to Engineering

Learning Objectives:
Overview of various Engineering disciplines, processes, and careers such as Mechanics, Kinematics, Drafting, Mechatronics, Automation,, and Materials Science.
Describe how these disciplines are exhibited in various manufacturing processes.
Identify and describe careers in the engineering field, the pay scales in that job sector, and the required educational and training.
Understand the past, present and future trends that affect careers, such as technological developments and societal trends, and the resulting need for lifelong learning.
Basic measuring and math skills: use of measurement instruments such as ruler, caliper, and micrometer.
Students apply math concepts to solve multistep problems, word problems, single variable equations, and simplifying fractions to actual measurement situations in the shop.

Effectively utilize engineering, architecture, and metric scales
Shop Safety: equipment use overview and safety procedures, general industrial workplace safety issues.

Sample Assignments or Projects
Working in pairs or triads, students research various engineering processes and present their research to an authentic audience.
After guest speakers/presentations/tours from the engineering industry students have discussions and write reflections.
Students analyze the safety of the school shop/classroom and an industrial workplace. Students practice safety in the classroom at all times.

Anchor Standards: 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 4.1, 4.2, 4.3, 4.4, 4.5 4.6, 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 7.2, 7.3, 7.8, 8.2, 8.4, 8.6, 9.2, 9.3, 9.4, 9.5, 9.6, 10.1, 10.4, 11.1
Pathway Standards: B6.4, B7.2, B7.4, B7.6, B9.1, B9.2

Unit 2: Fundamentals of Technical Drawing
Learning Objectives:
Utilize American National Standards Institute (ANSI) and International Standards Organization (ISO) drafting standards
Understand the components of a CAD workstation
Effectively use the latest release of the AutoCAD and Inventor software programs in a two-dimensional and three-dimensional workspace
Utilize drawing aids for entity accuracy
Perform various geometric constructions
Construct and edit two and three dimensional CAD drawing entities
Effectively utilize multiple layers
Construct multi-view drawings utilizing orthographic projection
Utilize auxiliary view techniques
Utilize sectioning techniques
Represent various fasteners
Create and modify simplified custom templates to industry standards
Correctly dimension working detail drawings
Place and edit detail drawing annotations
Print hard copies of two-dimensional and three-dimensional detail drawings
Perform efficient Computer-Aided Drafting (CAD) related file management techniques

Sample Assignments: Students will have direct instruction in the computer lab and will then show proficiency on:
Design Visualization:
Drawing Types
Image Planes
Design Process
Advantages of Prototyping
Advantages of 3D Renderings and Conceptualization
Types of Views: Oblique, Isometric, and Perspective
Types of Sketches: Technical, Artistic, Working Drawings
CAD Workstation Components:

Computer Hardware: CPU, Motherboards, Memory, Hard Drives, Video Cards, Power Supplies, ROM
Computer Software: Operating Systems, GUI
Input and Output Devices: Monitors, Keyboards, Mice, 3D Mice, Tablets, Digitizers, Printers, Scanners
Storage Devices: Flash Drives, Servers, NAS, Raid Types
Technical Drawing Tools:
Typical Hand Drafting Tools: T-Squares, Triangles, Drafting Machines, Parallel Arms, Protractors, Erasing Shields, French Curves, Splines, Compasses, and Templates
Hand Drafting Best Practices
How to Use and Read Scales: Architectural, Engineering, and Metric
ANSI and ISO Standards:
Line Weights
Line Types – Alphabet of Lines and Precedence of Lines
Paper Sizes
Text Heights, Standards, and Applications
Engineering Geometry and Construction
2D Coordinate and 3D Coordinate Systems
Absolute vs. Relative Coordinates
World Coordinate System vs. Local Coordinate Systems
Geometric Terms: Points, Lines, Parallel, Perpendicular, Intersections, Tangency, Circle Definitions, Concentric, Eccentric, Inscribed, Circumscribed, Classification of Angles, Classification of Quadrilaterals, Polygons, Regular Polygons, Classification of Triangles
Standard Drafting Constructions: How to Bisect a Line, How to Bisect an Angle, How to Find the Center of a Radius, How to Find the Center of a Circle
Multiview Drawings
Orthographic Projection and Best Practices
U.S. Standard Third Angle Projection vs. ISO Standard First Angle Projection
Glass Box Method, Plane of Projection, Six Principal Views and the Number of Views Actually Needed
General Layout, Construction Lines, Miter Lines
Representations of Various Types of Machines Holes
Representations of Fillets and Chamfers
Auxiliary Views
Descriptions and Applications
Inclined Planes and Oblique Planes
Auxiliary View Classifications: Primary, Secondary, Tertiary
Partial Auxiliary Views vs. Full Auxiliary Views
Dimensioning
Dimensioning Terminology, Standards, Applications, Symbology
Size and Location
Types of Dimensioning: Datums, Chain, Baseline, Coordinate
Screw threads and fastener representation
Dual Dimensioning vs. Double Dimensioning
Dimensioning Guidelines
Section Views
Definitions and Applications,
Cutting Planes vs. Viewing Planes
Dimension Placement, Alignment, Offset Distances
How to Dimension Standard Hole Types
Standard Protocol: Linetypes, Lineweight, Labels, Hatching, Omitting Lines, How to Deal With Standard

Hardware, How to Section Thin and Thick Parts
Types of Sections: Full, Half, Broken, Revolved, Removed, Offset, Assembly, Auxiliary
True Sections vs. Preferred Sections
Tolerancing Practices for Both ANSI and ISO
Tolerancing Terminology and Applications
How to Properly Apply Tolerances
Classification of Fits
Tolerance Stack-Up
Surface Symbols
AutoCAD and Inventor Fundamentals
User Interface
2D Cartesian Coordinate System
Basic Drawing and Editing Commands
Drawing Precision
Object Modification
Layer Management
Advanced Object Types
Analyzing Model and Object Properties
Advanced Editing Commands
Inserting Blocks
Layouts and Printing
Text and Tables
Hatching
Adding Dimensions
Working Effectively With AutoCAD
Accurate Positioning
Parametric Drawing
Working With Blocks
Creating Templates
Advanced Layouts
Annotation Styles
External References
Students who earn an A or B are eligible to sit for the 3 hour final exam for DDGT 110 at Napa Valley College
Anchor Standards: 2.6, 4.1, 5.1, 5.2, 5.3, 5.4, 7.2, 7.4, 7.5, 8.1, 8.2, 8.4, 8.6, 8.7, 9.7, 10.1, 10.2, 10.3, 10.4, 11.1, 11.2, 11.3, 11.4, 11.5
Pathway Standards: B1.1, B1.2, B1.3, B1.4, B1.5, B2.1, B2.2, B2.3, B6.5

Unit 3: Mechanical Design & Civil Engineering
Learning Objectives:
Engineering Techniques & Processes
Prototyping
Primary and secondary manufacturing process
Materials and their characteristics
Properties of epoxies and adhesives
Physics Principles
Force vectors
Rate and proportion problems relating to motion
Energy change in mechanical situations

The power expended in mechanical situations
Energy conservation to determine the thermal loss due to friction
Mechanical advantage and efficiency of a simple machine
Boat Building
Principles of buoyancy
Water displacement calculations
Design considerations
Construction considerations
Bridge Building
Types of bridges, design considerations
Materials used, pros and cons
Bridge design efficiency

Sample Assignments
Students use CAD software to design a 3D model of prototype parts and assemblies. Students create a physical model using a 3D printer. Students evaluate their physical model and propose possible design changes.
Material Identification Challenge: Students research different materials: various metals, alloys, plastics, concretes, how they are produced, prepared for processing, and utilized in engineering. Students research how materials are combined for structural strength and efficiency.
Students explain various manufacturing processes and categorize them as subtractive or additive, and present their findings.
Composite Layup Lab: students explore and test the properties of composite materials such as fiberglass, carbon fiber.
Motion lab: using gears, bearings and shafts, belts, and chains, students explore torque, linear speed and rotational velocities.
Work-energy theorem: students explore energy throughput efficiency, loss through friction and heat creation.
Bridge Building Challenge: students design and build bridges with popsicle sticks and wood glue. Bridges are tested until they fail and are then redesigned and retested.
Boat Building Challenge: Students design and build boats out of cardboard determining area, volume, and stability of various shapes and designs. Students calculate water displacement for given amount of weight of cargo. Students design and build a paddle or propulsion mechanism, then they race them in the swimming pool.

Anchor Standards: 2.5, 5.1, 5.2, 5.3, 5.4, 6.3, 6.4, 6.5, 6.6, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 9.2, 9.3, 9.6, 9.7, 10.1, 10.2, 10.3, 10.4, 11.1, 11.2, 11.3, 11.4, 11.5
Pathway Standards: B4.1, B4.2, B4.3, B4.4, B4.5, B5.1, B5.2, B5.3, B5.4, B5.5, B6.1, B6.2, B6.3, B6.6, B6.7, B7.1, B7.3, B7.5

Unit 4: Automation and Robotics
Learning Objectives:
Electricity Basics
Charge and current, conductor vs. insulator, resistance, voltage and energy
Ohm's law, and electrical power
Transistors, how they work
Mechanical and Fluid Power systems
Electric motors: electric currents and magnetic fields
Pneumatics and hydraulics:force output, the area of piston, and pressures

Robotics: uses in manufacturing, agriculture, healthcare, and other industries.
Programming: writing code to run a microcontroller and industrial controllers for robots and other automated systems .

Sample Assignments
Students describe the differences between DC and AC current. Students demonstrate use of a multimeter and the various settings and their meaning.
Circuit Construction and Analysis Lab: students create a circuit using devices to control electrical flow.
Worksheets involving Ohm's Law and power calculations
Motor Construction Lab Activity and Motor Research Presentation: students construct an electrical motor, and run it and test its function. Students explain the principles of why the motor runs.
Pneumatic/hydraulic System Design Challenge: Students identify the components of a fluid power system and design a system to demonstrate the relationship between the area of piston, force output, and the pressure of the system to create physical motion.
Students research how robots are used in various industries describe the advantages and disadvantages to using robots and automation.
Robot Coding Challenge: students assemble a robot and create code using a programmable logic controller, sensors, and motors. Students compete to see who's robot will autonomously follow a predetermined line track.

Anchor Standards: 2.5, 5.1, 5.2, 5.3, 5.4, 6.3, 6.4, 6.5, 6.6, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 9.2, 9.3, 9.6, 9.7, 10.1, 10.2, 10.3, 10.4, 11.1, 11.2, 11.3, 11.4, 11.5
Pathway Standards: B3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, B3.8, B8.1, B8.2, B8.3, B8.4, B8.5, B8.6, B10.1, B10.2, B10.3

Unit 5: College and Career Readiness
Learning Objectives:
Know the personal qualifications, interests, aptitudes, knowledge, and skills necessary to succeed in careers.
Develop a career plan that is designed to reflect career interests, pathways, and postsecondary options.
Understand the role and function of professional organizations, industry associations, and organized labor.
Identify work-related cultural differences to prepare for a global workplace.
Know the main strategies for self-promotion in the hiring process, such as completing job applications, resume writing, interviewing skills, and preparing a portfolio.

Sample Assignments
Students conduct a self-assessment and explain how professional qualifications affect career choices.
Students contact a professional organization and identify the steps to become a member.
Students write a resume, cover letter, thank you letter, and complete a sample job application.
Students participate in mock job interviews.
Students start a digital career portfolio with samples of their work.

Anchor Standards: 2.5, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 4.3, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7, 9.1, 9.4, 9.6, 11.4, 11.5,
Pathway Standards: B11.1, B11.2

INSTRUCTIONAL STRATEGIES
Lecture and Demonstrations

Multimedia Sources
Project-Based Learning
Work-Based Learning

INSTRUCTIONAL MATERIALS / TEXTBOOKS

Title: "Engineering Fundamentals, An introduction to Engineering", 5th edition, Saeed Moaveni. Cengage Learning [new - request for adoption approval submitted at this Board Meeting]

SUPPLEMENTAL INSTRUCTIONAL MATERIALS
"Engineering Fundamentals", 2nd edition, Brown, Brown and Berkeihiser. Goodheart-Willcox
"Technical Graphics Communication", 4th edition, Bertoline, Wiebe, Hartman, Ross. McGraw Hill
Autodesk Inventor Tutorials

STANDARDS SUMMARY

Anchor Standards: 1.0, 2.1-2.6, 3.1-3.9, 4.1-4.6, 5.1-5.4, 6.1-6.7, 7.1-7.8, 8.1-8.7, 9.1-9.7, 10.1-10.4, 11.1-11.5
Pathway Standards: B1.1-1.5, B2.1-2.3, B3.1-3.8, B4.1-4.5, B5.1-5.5, B6.1-67, B7.1-7.6, B8.1-8.6, B9.1, B9.2, B10.1-10.3, B11.1, B11.2
Common Core Standards: LS 11-12.1, 11-12.1, RSIT 11-12.2, RLST 11-12.2, 11-12.4, 11-12.7, 11-12.10, 11-12, WS 11-12.1, 11-12.2, 11-12.5, 11-12.6, 11-12.7, 11-12.8, A-CED 1, 2, 3, A-REI 1, 2, 3, 4, F-IF 1, 7, 8, F-TF 1, 2, 3, 5, G-CO 12, G-GMD 5, G-MG 3, G-SRT 1, N-Q 1, 2, 3, N-VM 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 1, 12, S-ID 1, 2, 3, 4, 5, 6, APPS 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 11.0, 12.0 13.0, 14.0, 15.0, 16.0, 17.0, 18.0, 19.0, SEP 1, 2, 3, 4, 5, 6, 7, 8, CC 1, 2, 3, 4, 5, 6, 7, PS1, PS2, PS3, PS4, ESS2, ESS3, ETS1, ETS2, AD 12.3, 12.7, PE 12.2, 12.6, US 11.8, WH 10.3, 10.9, 10.10, 10.11