

Course Outline

Engineering and Architecture

REVISED: August/2017

Job Title
CAD Technician

Career Pathway:
Engineering Design

Industry Sector:
Engineering and Architecture

O*NET-SOC CODE:
17-3012.01

CBEDS Title:
Electrical/Electronic Drafting

CBEDS No.:
5706

79-25-75

Computer-Aided Drafting (CAD) Technician (Upgrade)

Credits: 10

Hours: 120

Course Description:

This competency-based course is designed to train students for employment in the electronic drafting field. Instruction includes schematic diagrams, block diagrams, military standards, specification control drawings, printed circuit boards, color codes, logic diagrams, integrated circuit drawings, interconnection diagrams, and drafting machines. The competencies in this course are aligned with the California High School Academic Content Standards and the California Career Technical Education Model Curriculum Standards.

Prerequisites:

Enrollment requires one year of high school drafting or equivalent experience.

NOTE: For Perkins purposes this course has been designated as a **capstone** course.

This course cannot be repeated once a student receives a Certificate of Completion.



COURSE OUTLINE COMPETENCY-BASED COMPONENTS

A course outline reflects the essential intent and content of the course described. Acceptable course outlines have six components. (Education Code Section 52506). Course outlines for all apportionment classes, including those in jails, state hospitals, and convalescent hospitals, contain the six required elements:

(EC 52504; 5CCR 10508 [b]; Adult Education Handbook for California [1977], Section 100)

COURSE OUTLINE COMPONENTS

LOCATION

GOALS AND PURPOSES

Cover

The educational goals or purposes of every course are clearly stated and the class periods are devoted to instruction. The course should be broad enough in scope and should have sufficient educational worth to justify the expenditure of public funds.

The goals and purpose of a course are stated in the COURSE DESCRIPTION. Course descriptions state the major emphasis and content of a course, and are written to be understandable by a prospective student.

PERFORMANCE OBJECTIVES OR COMPETENCIES

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Objectives should be delineated and described in terms of measurable results for the student and include the possible ways in which the objectives contribute to the student's acquisition of skills and competencies.

Performance Objectives are sequentially listed in the COMPETENCY-BASED COMPONENTS section of the course outline. Competency Areas are units of instruction based on related competencies. Competency Statements are competency area goals that together define the framework and purpose of a course. Competencies fall on a continuum between goals and performance objectives and denote the outcome of instruction.

Competency-based instruction tells a student before instruction what skills or knowledge they will demonstrate after instruction. Competency-based education provides instruction which enables each student to attain individual goals as measured against pre-stated standards.

Competency-based instruction provides immediate and continual repetition and In competency-based education the curriculum, instruction, and assessment share common characteristics based on clearly stated competencies. Curriculum, instruction and assessment in competency-based education are: explicit, known, agreed upon, integrated, performance oriented, and adaptive.

COURSE OUTLINE COMPETENCY-BASED COMPONENTS
(continued)

COURSE OUTLINE COMPONENTS

LOCATION

INSTRUCTIONAL STRATEGIES

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Instructional techniques or methods could include laboratory techniques, lecture method, small-group discussion, grouping plans, and other strategies used in the classroom.

Instructional strategies for this course are listed in the TEACHING STRATEGIES AND EVALUATION section of the course outline. Instructional strategies and activities for a course should be selected so that the overall teaching approach takes into account the instructional standards of a particular program, i.e., English as a Second Language, Programs for Adults with Disabilities.

UNITS OF STUDY, WITH APPROXIMATE HOURS ALLOTTED FOR EACH UNIT

Cover

The approximate time devoted to each instructional unit within the course, as well as the total hours for the course, is indicated. The time in class is consistent with the needs of the student, and the length of the class should be that it ensures the student will learn at an optimum level.

pp. 7-11

Units of study, with approximate hours allotted for each unit are listed in the COMPETENCY AREA STATEMENT(S) of the course outline. The total hours of the course, including work-based learning hours (community classroom and cooperative vocational education) is listed on the cover of every CBE course outline. Each Competency Area listed within a CBE outline is assigned hours of instruction per unit.

EVALUATION PROCEDURES

pp. 13-14

The evaluation describes measurable evaluation criteria clearly within the reach of the student. The evaluation indicates anticipated improvement in performances as well as anticipated skills and competencies to be achieved.

Evaluation procedures are detailed in the TEACHING STRATEGIES AND EVALUATION section of the course outline. Instructors monitor students' progress on a continuing basis, assessing students on attainment of objectives identified in the course outline through a variety of formal and informal tests (applied performance procedures, observations, and simulations), paper and pencil exams, and standardized tests.

REPETITION POLICY THAT PREVENTS PERPETUATION OF STUDENT ENROLLMENT

Cover

After a student has completed all the objectives of the course, he or she should not be allowed to reenroll in the course. There is, therefore, a need for a statement about the conditions for possible repetition of a course to prevent perpetuation of students in a particular program for an indefinite period of time.

ACKNOWLEDGMENTS

Thanks to ALEJANDRA SALCEDO and LUZ GRANADOS for developing and editing this curriculum. Acknowledgment is also given to ERICA ROSARIO for designing the original artwork for the course covers.

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CALIFORNIA CAREER TECHNICAL EDUCATION MODEL CURRICULUM STANDARDS
Engineering and Design Industry Sector Industry Sector
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.

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.

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.

5.0 Problem Solving and Critical Thinking

Conduct short, as well as more sustained research projects to create alternative solutions to answer a question or solve a problem unique to the Engineering and Architecture sector using critical and creative thinking; logical reasoning, analysis, inquiry, and problem-solving techniques.

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 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.

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.

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 organization.

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.

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.

Engineering and Architecture Pathway Standards

C. Engineering Design Pathway

The Engineering Design pathway provides learning opportunities for students interested in preparing for careers in the design and production of visual communications.

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.
- C2.0 Understand the effective use of engineering design equipment.
- C3.0 Understand the sketching process used in concept development.
- C4.0 Understand measurement systems as they apply to engineering design.
- C5.0 Use proper projection techniques to develop orthographic drawings.
- C6.0 Understand the applications and functions of sectional views.
- C7.0 Understand the applications and functions of auxiliary views.
- C8.0 Understand and apply proper dimensioning standards to drawings.
- C9.0 Understand the tolerance relationships between mating parts.
- C10.0 Understand the methods of applying text to a drawing.
- C11.0 Understand the methods of creating both written and digital portfolios.

CBE
Competency-Based Education

COMPETENCY-BASED COMPONENTS
for the Computer-Aided Drafting (CAD) Technician (Upgrade) Course

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>A. SCHEMATIC DIAGRAMS</p> <p>Understand the purpose of the course and identify the personal skills needed to succeed in the mechanical CAD drafting field.</p> <p>(18 hours)</p>	<ol style="list-style-type: none"> 1. Estimate size of drawing sheet. 2. Demonstrate use of electronic template. 3. Demonstrate reference designation of components. 4. Compile a reference notebook. 	<p>Career Ready Practice: 1, 2, 4, 5</p> <p>CTE Anchor: Communications: 2.5 Problem Solving and Critical Thinking: 5.4 Demonstration and Application: 11.1</p> <p>CTE Pathway: C2.1, C2.2, C2.3, C5.1, C10.4</p>
<p>B. BLOCK DIAGRAMS</p> <p>Utilize skills obtained to prepare a final block diagram using correct sizes and titles. (2.0, 5.0, 6.0, 7.0, 9.0, 10.0, 11.0) (C2.0, C5.0)</p> <p>(6 hours)</p>	<ol style="list-style-type: none"> 1. Determine through calculations sheet space requirements. 2. Determine direction of signal flow. 3. Demonstrate use and knowledge of standard abbreviations list. 4. Demonstrate use of rectangular block. 5. Demonstrate use of arrows. 	<p>Career Ready Practice: 1, 2, 5</p> <p>CTE Anchor: Communications: 2.5 Problem Solving and Critical Thinking: 5.4 Demonstration and Application: 11.1</p> <p>CTE Pathway: C2.1, C2.2, C2.3, C5.1</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>C. MILITARY STANDARDS</p> <p>Understand the use of military standards manuals as applied to the drafting of electronic components.</p> <p>(9 hours)</p>	<ol style="list-style-type: none"> 1. Demonstrate correct and accurate use of the military standards index. 2. Demonstrate use of military standards sheets. 3. Demonstrate locating information data. 4. Comprehend and use engineering drawings. 5. Demonstrate use of electronic parts list. 	<p>Career Ready Practice: 2, 5</p> <p>CTE Anchor: Communications: 2.5 Problem Solving and Critical Thinking: 5.4 Technical Knowledge and Skills: 10.1 Demonstration and Application: 11.1</p> <p>CTE Pathway: C2.1, C2.2, C2.3, C5.1</p>
<p>D. SPECIFICATION CONTROL DRAWINGS</p> <p>Utilize knowledge obtained to correctly prepare outline drawings of electronic components.</p> <p>(6 hours)</p>	<ol style="list-style-type: none"> 1. Draw electronic components through system of dimension outline, component symbols, and construction. 2. Use specification notes in component catalogues to locate component rating and manufacturer. 	<p>Career Ready Practice: 2, 4, 5</p> <p>CTE Anchor: Communications: 2.5 Problem Solving and Critical Thinking: 5.4 Technical Knowledge and Skills: 10.1, 10.3 Demonstration and Application: 11.1</p> <p>CTE Pathway: C2.1, C3.1, C5.1</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>E. PRINTED CIRCUIT BOARDS</p> <p>Comprehend and construct five major drawings required to fabricate a printed circuit board.</p> <p>(30 hours)</p>	<ol style="list-style-type: none"> 1. Develop a schematic master drill drawing. 2. Construct assembly and parts list. 3. Prepare printed circuit layout using gridded mylar, board and component layout, and conductor lines. 4. Prepare a master using adhesive tape and decals, register marks, reduction notes, trim lines, and printed circuit board identification. 5. Draw a printed circuit board drill drawing using board outline dimensions, component hole dimensions, materials required, and finishes required. 6. Construct assembly drawing and complete parts list for printed circuit including assembly of all components, component identification, and required MIL-STD notes (Military Standards). 	<p>Career Ready Practice: 2, 5</p> <p>CTE Anchor: Communications: 2.5 Problem Solving and Critical Thinking: 5.4 Technical Knowledge and Skills: 10.1, 10.3 Demonstration and Application: 11.1</p> <p>CTE Pathway: C5.1</p>
<p>F. COLOR CODES</p> <p>Identify electronic components by means of standard color code.</p> <p>(3 hours)</p>	<ol style="list-style-type: none"> 1. Identify resistor and capacitor ratings. 2. Identify by name and explain proper usage of each of the ten color codes. 	<p>Career Ready Practice: 2, 5</p> <p>CTE Anchor: Communications: 2.5 Problem Solving and Critical Thinking: 5.4 Technical Knowledge and Skills: 10.1 Demonstration and Application: 11.1</p> <p>CTE Pathway: C1.2, C2.3, C9.1</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>G. LOGIC DIAGRAMS</p> <p>Understand how to prepare a final logic diagram drawing with the aid of an electronic template.</p> <p>(9 hours)</p>	<ol style="list-style-type: none"> 1. Explain logic symbol ratio. 2. Demonstrate use of military standards logic template. 3. Demonstrate use of logic reference designations. 4. Demonstrate correct circuitry flow through use of arrowheads. 	<p>Career Ready Practice: 2, 5</p> <p>CTE Anchor: Communications: 2.5 Problem Solving and Critical Thinking: 5.4 Technical Knowledge and Skills: 10.1 Demonstration and Application: 11.1</p> <p>CTE Pathway: C2.1, C5.1</p>
<p>H. INTEGRATED CIRCUIT DRAWING</p> <p>Understand how to prepare correct and accurate drawings required to fabricate a printed circuit.</p> <p>(28 hours)</p>	<ol style="list-style-type: none"> 1. Explain the use and construction of dual-in-line (14 & 16 pin), flat packs, and elements. 2. Perform requirements for integrated circuit design layout on .100 Quadrill grid at 2x size layout, to include plated through holes, ground conductor layout, voltage conductor layout, integrated circuit pad diameter, and integrated chip layout. 3. Construct an integrated circuit dual-in-line drawing. 	<p>Career Ready Practice: 1, 2, 5</p> <p>CTE Anchor: Communications: 2.5 Problem Solving and Critical Thinking: 5.4 Technical Knowledge and Skills: 10.1, 10.3 Demonstration and Application: 11.1</p> <p>CTE Pathway: C2.1, C5.1</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>I. INTERCONNECTION DIAGRAMS</p> <p>Demonstrate knowledge of interconnection diagrams.</p> <p>(6 hours)</p>	<p>1. Describe the design and application of reference designated such as jacks, plugs, cables, and units.</p>	<p>Career Ready Practice: 2, 4</p> <p>CTE Anchor: Communications: 2.5 Technical Knowledge and Skills: 10.1 Demonstration and Application: 11.1</p> <p>CTE Pathway: C2.1, C5.1</p>
<p>J. DRAFTING MACHINE</p> <p>Demonstrate accurate knowledge of drafting machine.</p> <p>(4 hours)</p>	<p>1. Demonstrate accurate knowledge and proper use of drafting machine scales.</p> <p>2. Demonstrate correct angle construction.</p>	<p>Career Ready Practice: 1, 4, 5</p> <p>CTE Anchor: Problem Solving and Critical Thinking: 5.4 Demonstration and Application: 11.1</p> <p>CTE Pathway: C2.1, 2.2, C2.3, C4.1, C4.2, C5.1</p>
<p>K. EMPLOYABILITY SKILLS</p> <p>Understand career paths and strategies for obtaining employment.</p> <p>(1 hour)</p>	<p>1. Explore career opportunities and projected trends; investigate required education, training and experience; and develop an individual education plan.</p> <p>2. Identify steps for setting goals and writing personal goals and objectives.</p> <p>3. Develop a career portfolio, including the following documents:</p> <ul style="list-style-type: none"> a. job application b. résumé(s) c. appropriate cover and follow-up correspondence <p>4. Identify and demonstrate effective interviewing techniques.</p> <p>5. Describe customer service as a method of building permanent relationships between the organization and the customer.</p>	<p>Career Ready Practice: 2</p> <p>CTE Anchor: Communications: 2.5</p> <p>CTE Pathway: 11.1</p>

SUGGESTED INSTRUCTIONAL MATERIALS and OTHER RESOURCES

TEXTS AND SUPPLEMENTAL BOOKS

Aubin, Paul F, Darryl McClelland, Martin Schmid, Gregg Stanley. Aubin Academy Master Series: AutoCAD MEP 2012. CreateSpace, 2011.

Larkin, John C.. Practical Problems in Mathematics for Drawing and CAD, 3rd Edition. Cengage Learning, 2004.

Madsen, David. Geometric Dimensioning and Tolerancing: Based on Asme Y14.5-2009 8th Edition. Goodheart-Willcox Publishing, 2010.

Pennisi-Vazzana, Mary Ellen and David Driver. Designing Mechanical Systems Using Autodesk Building Systems. Cengage Learning, 2003.

Mechanical Drawing: Board and CAD Techniques. Glencoe/McGraw-Hill, 2008.

SOFTWARE PROGRAMS

Autodesk. Auto CAD (latest version). <http://usa.autodesk.com>

RESOURCES

Employer Advisory Board members

CTE Foundation Standards

<http://www.cde.ca.gov/ci/ct/sf/documents/ctestandards.pdf>

<http://www.cde.ca.gov/be/st/ss/documents/ctestandards.doc>

Accrediting Commission of Career Schools and Colleges of Technology (ACCCT), 2101 Wilson Blvd., Suite 302, Arlington, VA 22201. Phone: (703) 247-4212. Fax: (703) 247-4533.

American Design Drafting Association (ADDA), 105 E. Main St., Newbern, TN 38059. Phone: (731) 627-0802. Fax: (731) 627-9321.

COMPETENCY CHECKLIST

TEACHING STRATEGIES and EVALUATION

METHODS AND PROCEDURES

- A. Lecture and discussion
- B. Multimedia presentations
- C. Demonstrations and participations
- D. Individualized instruction
- E. Peer teaching
- F. Role-playing
- G. Guest speakers
- H. Field trips and field study experiences
- I. Projects

EVALUATION

SECTION A – Schematic Diagrams – Pass all assignments and exams on schematic diagrams with a minimum score of 80% or higher.

SECTION B – Block Diagrams – Pass all assignments and exams on block diagrams with a minimum score of 80% or higher.

SECTION C – Military Standards – Pass all assignments and exams on military standards with a minimum score of 80% or higher.

SECTION D – Specification Control Drawings – Pass all assignments and exams on specification control drawings with a minimum score of 80% or higher.

SECTION E – Printed Circuit Boards– Pass all assignments and exams on printed circuit boards with a minimum score of 80% or higher.

SECTION F –Color Codes – Pass all assignments and exams on color codes with a minimum score of 80% or higher.

SECTION G – Logic Diagrams – Pass all assignments and exams on logic diagrams with a minimum score of 80% or higher.

SECTION H – Integrated Circuit Drawing – Pass all assignments and exams on integrated circuit drawing with a minimum score of 80% or higher.

SECTION I – Interconnection Diagrams – Pass all assignments and exams on interconnection diagrams with a minimum score of 80% or higher.

SECTION J – Drafting Machine – Pass all assignments and exams on drafting machine with a minimum score of 80% or higher.

SECTION J – Employability Skills – Pass all assignments and exams on employability skills with a minimum score of 80% or higher.

Statement for Civil Rights

All educational and vocational opportunities are offered without regard to race, color, national origin, gender, or physical disability.
