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American Welding Society
 Accredited Testing Facility, 2001

Degree: A.S. - Welding Technology
 Certificates: Welding Technology
 Welding Metallurgy and Inspection
 Department Certificates:
 Gas Metal Arc, Flux Core Arc Welding Plate Gas
 Tungsten Arc Plate & Pipe Welding
 Pipe Welding
 Shielded Metal Arc Plate and Pipe
 Welding Equipment Maintenance
 and Blueprint Interpretation

DEGREES AND CERTIFICATES

Welding Technology Degree

Major Code: 011245A01

The Welding Technology degree provides skills and knowledge in manual and semi-automatic welding processes used in the metal fabrication and construction industries. Instruction covers materials, equipment, procedures, testing techniques, as well as, safety and blueprint reading. Competencies include techniques of joining ferrous and non-ferrous metals by the use of Shielded Metal Arc Welding (SMAW), Gas Metal Arc Welding (GMAW), Flux Cored Arc Welding (FCAW), and Gas Tungsten Arc Welding (GTAW), and welding procedures.

Student Learning Outcomes

Upon completion of this program, the student will be able to:

- select the correct electrode classification and parameters for various thickness of material and welding positions on ferrous and nonferrous metals.
- define principles of gas metal arc welding.
- interpret GMA electrode and classification and specification.
- describe gas metal arc (GMA) welding operations of various joint designs using selected electrodes on different positions.
- describe shielded metal arc welding operations of various positions using selected electrodes on different joint designs.
- define principles of arc welding.
- select correct electrode amperage settings for the job application.
- identify gas tungsten arc (GTA) welding principles and safe welding practices.
- define GTA applications and limitations.
- explain the reason for the formation of each discontinuity type, and distinguish different discontinuities.
- interpret fabrication blueprints using a systematic process.
- interpret graphic welding symbols.
- relate the requirements for welding ferrous and nonferrous metals.
- select the appropriate setting and application methods.
- list the methods used for discontinuity prevention and identify surface defects in welds.

Career Opportunities

Graduating students may find welding positions in oil refineries, nuclear power plants, aerospace, structural buildings, bridge construction, auto industry, and small commercial fabricating shops.

Requirements for Degree 34 Units

WELD 140	Mathematics for Welding Technicians	3
WELD 300	Introduction to Welding.....	3
WELD 302	Introduction to Welding Metallurgy	3
WELD 316	Welding Inspection.....	2
WELD 320	Shielded Metal Arc Welding – Structural	3
WELD 322	Shielded Metal Arc Welding (Pipe)	3
WELD 330	Gas Tungsten Arc Welding (Plate).....	3
WELD 332	Gas Tungsten Arc Welding (Pipe).....	3
WELD 333	Gas Metal Arc Welding, Semi-Automatic Processes.....	3
WELD 334	Gas Metal Arc Welding: Ferrous and Non-Ferrous Metals	2
WELD 335	Flux Core Arc Welding.....	3
WELD 342	Symbol Reading, Layout and Fabrication	3

Associate Degree Requirements: The Welding Technology Associate in Science (A.S.) Degree may be obtained by completion of the required program, plus general education requirements, plus sufficient electives to meet a 60-unit total. See ARC graduation requirements.

Welding Technology Certificate

Major Code: 011245C02

This certificate provides skills and knowledge in manual and semi-automatic welding processes used in the metal fabrication and construction industries. Instruction covers materials, equipment, welding procedures, testing techniques, inspection, welding metallurgy, blueprint reading, and welding safety. Competencies include techniques of joining ferrous and non-ferrous metals by the use of Shielded Metal Arc Welding (SMAW), Gas Metal Arc Welding (GMAW), Flux Cored Arc Welding (FCAW), and Gas Tungsten Arc Welding (GTAW). Oxyacetylene welding, oxyacetylene cutting and plasma arc cutting, are also covered.

Student Learning Outcomes

Upon completion of this program, the student will be able to:

- list the factors that must be considered before a welding process is selected
- evaluate a weld according to a given standard or code
- compare the three types of welding current used for Gas Tungsten Arc Welding
- define voltage, electrical potential, amperage, and electrical current as related to Gas Metal Arc Welding
- discuss how the Gas Metal Arc Welding molten weld pool can be controlled by varying the shielding gas, power settings, weave pattern, travel speed, electrode extension, and gun angle
- explain what each of the digits in a standard Flux Cored Arc Welding electrode identification number mean
- list and define the three units used to measure a welding current
- give the characteristics of the three filler metal groups E6010 and E6011, E6012 and E6013, and E7016 and E7018

- discuss three general categories of pipe welds including how they are used and what type of weld root penetration and strength they require
- make a single V-groove butt welded joint on a pipe in any position to code specifications
- list the crystalline structures of metals and explain how grains form
- describe practical applications of metallurgy
- solve basic welding fabrication math problems
- read a set of welding blueprint drawings and explain each item shown and its dimensioning

Career Opportunities

Graduates may find employment in a number of industries including: pipe line construction, oil refining, aerospace, structural building, bridge construction, automotive, and small commercial fabricating. They may also work as welding shop supervisors and welding sales persons, and they can also become welding shop owners.

Requirements for Certificate		34 Units
WELD 140	Mathematics for Welding Technicians.....	3
WELD 300	Introduction to Welding.....	3
WELD 302	Introduction to Welding Metallurgy.....	3
WELD 316	Welding Inspection.....	2
WELD 320	Shielded Metal Arc Welding – Structural.....	3
WELD 322	Shielded Metal Arc Welding (Pipe).....	3
WELD 330	Gas Tungsten Arc Welding (Plate).....	3
WELD 332	Gas Tungsten Arc Welding (Pipe).....	3
WELD 333	Gas Metal Arc Welding, Semi-Automatic Processes.....	3
WELD 334	Gas Metal Arc Welding: Ferrous and Non-Ferrous Metals.....	2
WELD 335	Flux Core Arc Welding.....	3
WELD 342	Symbol Reading, Layout and Fabrication.....	3

Welding Metallurgy and Inspection (270 hours) Certificate

Major Code: 011543C01

The Welding Metallurgy and Inspection certificate provides the science of metallurgy and weld inspection. Emphasis is on the identification and selection of irons and steel, mechanical and physical properties of metals and crystal structures of metals, rules and regulations of the welding construction industry, and principles, requirements and methods of inspection.

Student Learning Outcomes

Upon completion of this program, the student will be able to:

- describe the mechanical properties of different types of metals
- interpret and explain the Nondestructive Testing (NDT) procedures of codes and specifications relating to welding
- evaluate and explain in simple terms the reason for the formation of discontinuity in each of the welding processes
- explain different methods used for the prevention of weld discontinuities
- describe the crystalline structures of metals and explain how grain forms in metal
- explain the problems hydrogen causes when welding steel
- analyze phase diagrams of carbon and stainless steels

Requirements for Certificate		14 Units
WELD 117	Ultrasonic Testing Level One.....	3
WELD 118	Ultrasonic Testing Level Two.....	3
WELD 300	Introduction to Welding.....	3
WELD 302	Introduction to Welding Metallurgy.....	3
WELD 316	Welding Inspection.....	2

DEPARTMENT CERTIFICATES

Gas Metal Arc, Flux Core Arc Welding Plate (252 hours) Certificate

The Gas Metal Arc Welding certificate promotes competence in welding with different types of metal transfer, constant voltage power sources, different types of shielding gases, and electrode selection on various joint designs. Instruction is provided in gas metal and flux cored arc welding on fillet and groove welds to specific structural and pipe standards.

Student Learning Outcomes

Upon completion of this program, the student will be able to:

- select the correct electrode classification and parameters for various thicknesses of material and welding positions on ferrous and nonferrous metals
- define principles of gas metal arc welding
- interpret electrode classification and specification
- analyze gas metal arc welding operations on various joint designs using selected electrodes for different welding positions

Requirements for Certificate		11 Units
WELD 300	Introduction to Welding.....	3
WELD 333	Gas Metal Arc Welding, Semi-Automatic Processes.....	3
WELD 334	Gas Metal Arc Welding: Ferrous and Non-Ferrous Metals.....	2
WELD 335	Flux Core Arc Welding.....	3

Gas Tungsten Arc Plate and Pipe Welding (180 hours) Certificate

The Gas Tungsten Arc Welding certificate promotes competence in welding ferrous and nonferrous materials. Emphasis is on proper use of gas tungsten arc welding (GTA) equipment setup requirements, process variables, material requirements, and welding procedures that are in compliance with industry standards.

Student Learning Outcomes

Upon completion of this program, the student will be able to:

- identify GTA principles and safe practices.
- define GTA applications and limitations.
- weld mild steel, stainless steel, and aluminum alloys using GTA procedures in all positions.
- evaluate and demonstrate procedures for a given welding project or application.
- relate the requirements of welding ferrous and nonferrous materials.
- select the appropriate settings and applications methods of GTA process.

Requirements for Certificate		9 Units
WELD 300	Introduction to Welding.....	3
WELD 330	Gas Tungsten Arc Welding (Plate).....	3
WELD 332	Gas Tungsten Arc Welding (Pipe).....	3

Pipe Welding Certificate

This certificate promotes competence in pipe welding with emphasis on power sources, electrode/filler metal selection on various joint designs, techniques, and positions for welding. Instruction includes safety, math, and proper procedures in making fillet and groove welds that are in compliance with structural and pipe welding codes.

Student Learning Outcomes

Upon completion of this program, the student will be able to:

- interpret electrode and filler metal classifications and specifications
- select correct amperage setting for the job application
- define principles of arc welding
- perform Shielded Metal Arc Welding and Gas Tungsten Arc Welding operations in various positions using selected electrodes on different joint designs.
- use math in welding applications

Career Opportunities

Certificate completers may find employment in a number of industries, including PG&E pipeline construction, oil refining, power generation, structural building, bridge construction, and small commercial fabricating shops.

Requirements for Certificate		9 Units
WELD 140	Mathematics for Welding Technicians.....	3
WELD 322	Shielded Metal Arc Welding (Pipe).....	3
WELD 332	Gas Tungsten Arc Welding (Pipe).....	3

Shielded Metal Arc Plate and Pipe Certificate

This certificate promotes competence in plate and pipe welding. Emphasis is on power sources, electrode selection on various joint designs, techniques, and positions in welding. Instruction includes safety and proper procedures in making fillet and groove welds that are in compliance with structural and pipe welding codes.

Student Learning Outcomes

Upon completion of this program, the student will be able to:

- interpret electrode classification and specification
- select correct amperage setting for the job application
- define principles of arc welding
- certify and perform SMA operations in various positions using selected electrodes on different joint designs

Requirements for Certificate		9 Units
WELD 300	Introduction to Welding.....	3
WELD 320	Shielded Metal Arc Welding – Structural.....	3
WELD 322	Shielded Metal Arc Welding (Pipe).....	3

Welding Equipment Maintenance and Blueprint Interpretation (234 hours) Certificate

This certificate promotes competence in solving equipment, mathematical and manufacturing problems that apply to the welding trade. It emphasizes metal placement, measurement, and layout of tools used in construction, as well as the fundamentals of blueprint reading and welding equipment repair.

Student Learning Outcomes

Upon completion of this program, the student will be able to:

- evaluate algebraic expressions by substituting given numbers for letter values
- solve formulas by substituting numbers for letters, analyzing word statements and diagram values
- compute the area, radius, and diameter of a circle
- compute area, radius, and central angles of a sector
- measure angles in degrees, minutes, and seconds
- identify and demonstrate the proper use of common power tools and accessories used in the welding trade
- interpret fabrication blueprints using a systematic process
- interpret graphic welding symbols
- interpret electrical and electronically controlled circuits
- evaluate testing equipment used for welding maintenance repair

Requirements for Certificate		12 Units
WELD 107	Welding Equipment Maintenance.....	3
WELD 140	Mathematics for Welding Technicians.....	3
WELD 300	Introduction to Welding.....	3
WELD 342	Symbol Reading, Layout and Fabrication.....	3

Welding Technology

WELD 105 Introduction to Metal Sculpture 1.5 Units

Hours: 18 hours LEC; 27 hours LAB

This course covers metal sculpture techniques, design principles, and materials used for sculpture for functional and nonfunctional art forms, on ferrous and non-ferrous metals. Techniques on the major welding processes such as Shielded Metal Arc, Gas Metal Arc, Gas Tungsten Arc, and Oxy-Acetylene are an integral part of the course, as well as related safety issues.

WELD 107 Welding Equipment Maintenance 3 Units

Hours: 36 hours LEC; 54 hours LAB

This course covers the basics of welding equipment maintenance, troubleshooting, and repair. Electrical and electronically controlled circuits are discussed and tested. Overall theory of operation and safety are presented, as well as maintenance scheduling and the use of electronic test equipment and other measuring devices. Field trips may be required.

WELD 115 Code Welding 2 Units

Prerequisite: WELD 300 with a “C” grade or better, or a minimum of one year of welding experience.

Hours: 18 hours LEC; 54 hours LAB

This course provides individualized training for welder performance qualification. Code and test requirements are presented. Welders select the code, metal, process, and positions to be used. Preparation for competing in the SkillsUSA regional, state, and national competition is also covered. This course may be taken up to four times for credit with different competitions. A field trip and participation at the site of the SkillsUSA regional competition are required.

WELD 117 Ultrasonic Testing Level One 3 Units

Hours: 45 hours LEC; 27 hours LAB

This course covers the theory, technique, application, and evaluation used in the material processing, welding, and inspection industries. Ultrasonic testing as applied to industry practices, such as building construction, aeronautics, shipbuilding, materials fabrication, and others, is covered. Successful completion of this course certifies that the requirements of the American Society of Nondestructive Testing (ASNT) TC-1A for UT level I are met.

WELD 118 Ultrasonic Testing Level Two 3 Units

Prerequisite: WELD 117 with a "C" or better, or evidence of completion of UT Level I certification.

Hours: 45 hours LEC; 27 hours LAB

This course covers advanced theory, technique application, and evaluation techniques used in the material processing, welding, and inspection industries. It covers advanced ultrasonic testing as applied to industry practices such as building construction, aeronautics, shipbuilding, and materials fabrication. Successful completion of this course meets the requirements of the American Society of Nondestructive Testing (ASNT) TC1-A for Ultrasonic Testing Level II.

WELD 140 Mathematics for Welding Technicians 3 Units

General Education: AA/AS Area II(b)

Hours: 54 hours LEC

This course covers the application of mathematics principles in technical and trade work. Areas covered are fundamentals of general mathematics, common fractions, decimal fractions, percent, signed numbers, measurements, customary measurement units, metric measurement units, steel rules and vernier calipers, fundamentals of algebra, basic algebraic operations, fundamentals of plane geometry, triangles, polygons, circles, areas, volumes, and fundamentals of trigonometry.

WELD 150 Employability Skills for Technical Careers 2 Units

Same As: AT 107 and ET 250

Advisory: ENGWR 102 or 103, and ENGRD 116 with a grade of "C" or better; OR ESLR 320, ESLL 320, and ESLW 320 with a grade of "C" or better.

General Education: AA/AS Area III(b)

Hours: 36 hours LEC

This course provides the opportunity to explore technical careers while developing valuable work and life skills. It is an introduction to a variety of technically-related occupations, emphasizing technical careers in the Sacramento area. Activities are designed to enhance personal development, employability skills, and self esteem through leadership, citizenship, and character development. This course is not open to students who have completed AT 107 or ET 250.

WELD 155 Industry Training 3 Units

Hours: 36 hours LEC; 54 hours LAB

This course covers welding processes, knowledge, and skills specific to employers' needs. Workplace safety and etiquette are included. Metal fabrication skills for specific employment needs and welding certification testing are covered if requested by employers.

WELD 298 Work Experience in Welding 1-4 Units

Advisory: Eligible for ENGRD 310 or ENGRD 312 AND ENGWR 300; OR ESLR 340 AND ESLW 340.

Enrollment Limitation: Students must be in a paid or unpaid internship, volunteer position, or job related to the welding field with a cooperating site supervisor. Students are advised to consult with the Welding Department faculty to review specific certificate and degree work experience requirements.

General Education: AA/AS Area III(b) (effective Summer 2018)

Hours: 60-300 hours LAB

This course provides students with opportunities to develop marketable skills in preparation for employment or advancement within the welding field. It is designed for students interested in work experience and/or internships in associate degree level or certificate occupational programs. Course content includes understanding the application of education to the workforce, completion of Title 5 required forms which document the student's progress and hours spent at the work site, and developing workplace skills

and competencies. During the semester, the student is required to complete 75 hours of related paid work experience, or 60 hours of related unpaid work experience for one unit. An additional 75 or 60 hours of related work experience is required for each additional unit. All students are required to attend the first class meeting, a mid-semester meeting, and a final meeting. Additionally, students who have not already successfully completed a Work Experience course will be required to attend weekly orientations while returning participants may meet individually with the instructor as needed. Students may take up to 16 units total across all Work Experience course offerings. This course may be taken up to four times when there are new or expanded learning objectives. Only one Work Experience course may be taken per semester.

WELD 300 Introduction to Welding 3 Units

Course Transferable to CSU

Hours: 36 hours LEC; 54 hours LAB

This course is an introduction to welding processes, including shielded metal arc, gas metal arc, flux-cored gas shield and self shield, gas tungsten arc, oxyacetylene cutting and welding on joint designs, and positions used in industry. Safety in arc welding, oxyacetylene, and plasma cutting is also covered. Field trips may be required.

WELD 302 Introduction to Welding Metallurgy 3 Units

Corequisite: WELD 300

Hours: 36 hours LEC; 54 hours LAB

This course provides a general overview of basic metallurgy of ferrous and non-ferrous metals. Topics include various steel making processes, different types of furnaces, identifying types of steels, and their mechanical, physical, chemical, and electrical properties. Crystal structures of metals, the iron equilibrium diagram, the periodic table of elements emphasizing those elements associated with steels, metallurgical failure of welds, steel deformation, and heat treatment of steels are also covered. In addition, material hardness using different hardness testing methods, calculation of different steel strengths and stresses, and impact tests using the Charpy and Izod methods are covered. Field trips may be required.

WELD 316 Welding Inspection 2 Units

Prerequisite: WELD 300 with a grade of "C" or better; OR at least one year of welding experience.

Advisory: Eligible for ENGRD 310 or ENGRD 312 AND ENGWR 300; OR ESLR 340 AND ESLW 340.

Course Transferable to CSU

Hours: 36 hours LEC

This course covers the welding requirements for any type of welded structure made from commonly used carbon and low-alloy steel construction. Topics include welding construction industry, rules, regulations, and the principles, requirements, and methods of inspection. It covers weld measurements and discontinuities for evaluation acceptance using a variety of tools. It also emphasizes the lines of communication between the plant managers, welders, welding engineers, design/project engineers, welding foreman/supervisors, shop or field superintendents, and reporting supervisors. This course offers preparation for the Certified Welding Inspector Examination given by the American Welding Society.

WELD 320 Shielded Metal Arc Welding – Structural 3 Units

Prerequisite: WELD 300 with a grade of “C” or better; OR at least one year of welding experience.

Advisory: Eligible for ENGRD 310 or ENGRD 312 AND ENGWR 300; OR ESLR 340 AND ESLW 340.

Course Transferable to CSU

Hours: 36 hours LEC; 54 hours LAB

This course covers employment training for welding technicians. It emphasizes developing manipulative proficiency in the use of Shielded Metal Arc Welding (SMAW) in the horizontal (2F-2G), vertical (3F-3G), and overhead (4F-4G) positions on steel. It also covers filler metal classifications, welding power supplies, and welding safety. Welding test plates in accordance with the requirements to AWS D1.1 Structural Welding Code and AWS D1.5 Bridge Code are also covered.

WELD 322 Shielded Metal Arc Welding (Pipe) 3 Units

Prerequisite: WELD 320 with a grade of “C” or better; OR a minimum of 2 years of welding experience.

Advisory: Eligible for ENGRD 310 or ENGRD 312 AND ENGWR 300; OR ESLR 340 AND ESLW 340.

Course Transferable to CSU

Hours: 36 hours LEC; 54 hours LAB

This course covers the applications of shielded metal arc welding used to join low-pressure piping systems that carry water and residential natural gas. Topics include: welding required for high pressure critical piping systems such as steam pipe, fuel transportation pipe lines, boilers, offshore oil-rigs, and other critical heavy-duty piping systems.

WELD 330 Gas Tungsten Arc Welding (Plate) 3 Units

Prerequisite: WELD 300 with a grade of “C” or better; OR at least one year of welding experience.

Advisory: Eligible for ENGRD 310 or ENGRD 312 AND ENGWR 300; OR ESLR 340 AND ESLW 340.

Course Transferable to CSU

Hours: 36 hours LEC; 54 hours LAB

This course covers Gas Tungsten Arc Welding (GTAW) of aluminum, stainless steel, carbon steel, and other metals used in industry. This course content is relevant to code welding in accordance to the American Society of Mechanical Engineers Section 1X (ASME), the Structural welding Code D1.1 (AWS), and the American Petroleum Institute 1104 (API). It also covers filler metal selection, both specifications and classifications, shielding gases, welding power supplies, and welding safety. Certification and procedure qualification to code specifications are also covered.

WELD 332 Gas Tungsten Arc Welding (Pipe) 3 Units

Prerequisite: WELD 330 with a grade of “C” or better; WELD 330 with a grade of “C” or better, OR a minimum of two years of welding experience.

Advisory: Eligible for ENGRD 310 or ENGRD 312 AND ENGWR 300; OR ESLR 340 AND ESLW 340.

Course Transferable to CSU

Hours: 36 hours LEC; 54 hours LAB

This course covers the application of low-pressure and high-pressure critical piping systems used in oil, gas, nuclear, and chemical industries. It covers Gas Tungsten Arc Welding (GTAW) of aluminum pipe, stainless steel pipe, and carbon steel pipe. It explores code welding in accordance to the American Society of Mechanical Engineers Section 1X (ASME), Structural Welding Code D1.1 (AWS), and American Petroleum Institute 1104 (API). Certification and procedure qualification to ASME Section 1X, AWS D1.1, API 1104 code specifications are also covered.

WELD 333 Gas Metal Arc Welding, Semi-Automatic Processes 3 Units

Prerequisite: WELD 300 with a grade of “C” or better

Advisory: ENGWR 102 and ENGRD 116 with a grade of “C” or better; OR ESLR 320 and ESLW 320 with a grade of “C” or better.

Course Transferable to CSU

Hours: 36 hours LEC; 54 hours LAB

This course covers semi-automatic wire feed welding with micro wires on steel plate of varying thickness. Joint design, gas variations and all welding positions are also covered. The emphasis of this course is welding on low, medium, and high carbon steels. The course content is relevant to code welding in accordance to the American Welding Society (AWS), Structural welding Code D1.1 and Sheet Steel Code D1.3. Also covered are welding power supplies, types of metal transfer (spray, globular, pulsed-arc, and short circuit). This course also covers filler metal selection, both specifications and classifications, and shielding gases used for each type of transfer. Welding safety is also covered.

WELD 334 Gas Metal Arc Welding: Ferrous and Non-Ferrous Metals 2 Units

Prerequisite: WELD 133 with a grade of “C” or better

Advisory: ENGWR 102 and ENGRD 116 with a grade of “C” or better; OR ESLR 320 and ESLW 320 with a grade of “C” or better.

Course Transferable to CSU

Hours: 18 hours LEC; 54 hours LAB

This course covers semiautomatic wire feed welding using micro wires on aluminum and stainless steel plate of varying thickness. Joint design, gas variations and all welding positions are covered. The emphasis of this course is on code welding aluminum and stainless steels. The content of this course is relevant to code welding in accordance to the American Welding Society (AWS), Structural Aluminum Welding Code D1.2 and Structural Welding Stainless Steel Code D1.6. It also covers welding power supplies, types of metal transfer (spray, globular, pulsed-arc, and short circuit). This course also covers filler metal selection, both specifications and classifications, and shielding gases used for each type of transfer. Welding safety is also covered.

WELD 335 Flux Core Arc Welding 3 Units

Prerequisite: WELD 300 with a grade of “C” or better, or a minimum of one year of welding experience.

Course Transferable to CSU

Hours: 36 hours LEC; 54 hours LAB

This course provides training to develop semi-automatic welding skills on carbon steels. Topics include small and large diameter flux cored electrodes, with and without external shielding gas, in all positions on fillet and groove welds. It also provides a thorough technical understanding of the Flux Core Arc Welding process and arc welding safety.

WELD 342 Symbol Reading, Layout and Fabrication 3 Units

Corequisite: WELD 300

Course Transferable to CSU

Hours: 36 hours LEC; 54 hours LAB

This course covers blueprint and welding symbol interpretation. It includes metal layout, measurement, marking, and layout tools used in construction, and techniques of fabrication and assembly methods. It also covers fundamentals of blueprint reading, including basic lines and views, dimensions, notes and specifications, structural shapes, sections, detail, and assembly.