# ADVANCED DRAFTING & DESIGN

## COURSE DESCRIPTION

***Advanced Drafting & Design*** is a course in which students will learn to use a software program to create engineering drawings including architectural, civil or plan drawings, assembly drawings, welding and process drawings, cross sections, 3D representations, bills of materials and schedules. Emphasis is on drawings of increasing complexity.

***It is strongly recommended that administration and guidance follow the scope and sequence and course recommendations as listed.***

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| **Recommended:** | Computer Aided Drafting I & II; Algebra I, Geometry, Math and science requirements should be obtained according to graduation requirements during and prior to the conclusion of the credits. Concurrency is acceptable. |
| **Recommended Credits:** | 2 |
| **Recommended Grade Level(s):** | $11^{th}$ or $12^{th}$ |
| **Number of Competencies in Course:** | 37 |

*This course may be offered as a part of the Construction or the Manufacturing Sub-Cluster, depending upon the student's career focus.

## ADVANCED DRAFTING & DESIGN

### STANDARDS

**1.0** Students will take personal responsibility for the safety of themselves, their coworkers, and bystanders and perform safety examinations and maintain safety records.

**2.0** Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.

**3.0** Students will integrate reading, writing, math, and science skills and understand the impact of academic achievement in the workplace.

**4.0** Students will create and print two- and three-dimensional scale drawings and orthographic projections using a CAD program**.**

**5.0** Students will apply dimensions and tolerances as per ANSI standards to components of a drawing to assure a working fit between components.

**6.0** Students will research and apply professional standards of a specific discipline to increase their area of knowledge for the drafting and design profession.

**7.0** Students will apply professional design standards to specific real-life projects in related mechanical and/or architectural applications.

**8.0** Students will extract information from a technical drawing to create a bill of materials and/or schedules.

## ADVANCED DRAFTING & DESIGN

### STANDARD 1.0

Students will take personal responsibility for the safety of themselves, their coworkers, and bystanders and perform safety examinations and maintain safety records.

### LEARNING EXPECTATIONS

The student will:

**1.1** Pass with 100% accuracy a written examination on safety issues specific to this course of study.

**1.2** Pass with 100% accuracy a performance examination on tools and equipment specific to this course of study.

**1.3** Maintain a portfolio with a copy of written safety examinations and equipment examinations for which the student has passed an operational checkout by the instructor.

**1.4** Follow rules and regulations to comply with personal and lab safety standards to include general standards, fire, and electrical.

**1.5** Practice and apply health and safety OSHA standards as they pertain to the course.

**1.6** Select tools, technology, machinery, equipment, and materials appropriate for the given assignment.

### PREFORMANCE INDICATORS: EVIDENCE STANDARD IS MET

The student:

**1.1** Passes with 100% accuracy a written examination on safety issues specific to this course of study.

**1.2** Passes with 100% accuracy a performance examination on tools and equipment specific to this course of study.

**1.3** Maintains a portfolio record with a copy of written safety examinations and equipment examinations for which the student has passed an operational checkout by the instructor.

**1.4** Demonstrates and follows procedures for classroom and lab safety, fire safety, and electrical safety.

**1.5** Assesses and applies health and safety OSHA standards as they pertain to the course.

**1.6A** Demonstrates appropriate use of tools to complete assignments.

**1.6B** Identifies sources of information concerning state-of-the-art tools, equipment, materials, and technologies.

**1.6C** Identifies potential hazards related to use of tools and equipment.

### SAMPLE PERFORMANCE TASKS

- Assess the work area for safety hazards.
- Design a corrections program for identified hazards.
- Model the appropriate protective equipment for an assigned task.

- Read manufacturer specifications to determine safe practices while working on various electrical and electronic systems.
- Demonstrate personal safety (e.g., dress, eye and hearing devices, and jewelry).
- Demonstrate the handling and disposing of chemicals.
- Complete a safety inspection evaluating possible fire and water hazards.
- Develop a presentation on right to know laws and any other laws required for safety.
- Practice safe disposal procedures for chemicals used in related processes.
- Practice ergonomic processes when using the computers and equipment.
- Prepare an Occupational Safety and Health notebook for the Tennessee SkillsUSA Championships.

## INTEGRATION LINKAGES

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, Algebra, Geometry, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Skills USA *Professional Development Program* (PDP), SkillsUSA *Total Quality Program* (TQP)

## ADVANCED DRAFTING & DESIGN

## STANDARD 2.0

Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.

## LEARNING EXPECTATIONS

The student will:

**2.1** Cultivate positive leadership skills and work ethics.
**2.2** Participate in the approved student organization and other industry organizations directly related to their program of study as an integral part of classroom instruction.
**2.3** Assess situations, apply problem-solving techniques and decision-making skills within the school, community, and workplace.
**2.4** Participate as a team member in a technical learning environment.
**2.5** Be aware and adaptive to individual differences, customs, and culture of others.
**2.6** Demonstrate the development of a personal career plan identifying career organizations, interests, strengths and opportunities.
**2.7** Respect the opinions, direction, and constructive criticisms of career professionals and leaders.

## PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

**2.1A** Demonstrates character and leadership using creative-and critical-thinking skills.
**2.1B** Uses creative thought process by "thinking outside the box."
**2.2A** Relates the creed, purposes, motto, and emblem of their student organization, directly related to personal and professional development.
**2.2B** Plans and conducts meetings and other business according to accepted rules of parliamentary procedure.
**2.3A** Makes decisions and assumes responsibilities.
**2.3B** Analyzes a situation and uses a professional development program or career and technical student organization materials directly related to the student's program of study to resolve it.
**2.3C** Demonstrates an understanding of the importance of learning new information for both current and future problem solving and decision making.
**2.4A** Organizes committees and participates in functions.
**2.4B** Cooperates with peers to select and organize a community service project.
**2.5A** Researches different customs and individual differences of others.
**2.5B** Interacts respectfully with individuals of different cultures, gender, and backgrounds.
**2.6A** Creates personal career development by identifying career interests, strengths, and opportunities.
**2.6B** Identifies opportunities for career development and certification requirements.
**2.6C** Plans personal educational paths based on available courses and current career goals.
**2.6D** Creates a resume that reflects student's skills, abilities, and interests.
**2.6E** Demonstrates professional industry organization relationships to support career paths upon program completion.
**2.7** Resolves conflicts and differences to maintain a smooth workflow and classroom environment.

## SAMPLE PERFORMANCE TASKS

- Create a leadership inventory and use it to conduct a personal assessment.
- Participate in various career and technical student organization programs and/or competitive events.
- Implement an annual program of work.
- Prepare a meeting agenda for a specific career and technical student organization monthly meeting.
- Attend a professional organization meeting.
- Develop a program of study within their career interests.
- Participate in the American Spirit Award competition with SkillsUSA.
- Complete *Professional Development Program Level I and Level II*, SkillsUSA.
- Participate in National Design Drafting Week, Annual Drafting Contest, Annual Poster Contest.

## INTEGRATION LINKAGES

SkillsUSA, *Professional Development Program;* SkillsUSA; Communications and Writing Skills; Teambuilding Skills; Research; Language Arts; Sociology; Psychology; Math; English; Social Studies; Problem Solving; Interpersonal Skills; Employability Skills; Critical-Thinking skills; Secretary's Commission on Achieving Necessary Skills (SCANS); Chamber of Commerce; Colleges; Universities; Technology Centers; Secretary's Commission on Achieving Necessary Skills (SCANS)

## ADVANCED DRAFTING & DESIGN

## STANDARD 3.0

Students will integrate reading, writing, math, and science skills and understand the impact of academic achievement in the work place.

## LEARNING EXPECTATIONS

The student will:

**3.1** Be responsible for accomplishing classroom assignments and workplace goals within accepted time frames.
**3.2** Demonstrate advanced study skills.
**3.3** Demonstrate and use written and verbal communication skills.
**3.4** Read and understand technical documents, such as regulations, manuals, reports, forms, graphs, charts, and tables.
**3.5** Apply the foundations of mathematical principles, such as algebra, geometry, and advanced math, to solve problems.
**3.6** Apply basic scientific principles and methods to solve problems and complete tasks.
**3.7** **Demonstrate an** understanding of computer operations and related applications to input, store, retrieve, and output information as it relates to the course.
**3.8** Research, recognize, and understand the interactions of the environment and green issues as they relate to the course work and to a global economy.

## PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

**3.1A** Uses appropriate time management to achieve goals.
**3.1B** Arrives at class at an acceptable time each day.
**3.1C** Completes assignments and meets deadlines.
**3.1D** Arrives properly dressed and prepared.
**3.2A** Assesses current personal study skills.
**3.2B** Demonstrates advanced note-taking ability.
**3.2C** Formulates appropriate study strategies for given tasks.
**3.3A** Communicates ideas, information, and messages in a logical manner.
**3.3B** Fills out forms, reports, logs, and documents to comply with class and project requirements.
**3.4A** Reads and understands technical documents and uses industry jargon, acronyms, and terminology appropriately.
**3.4B** Recognizes the meaning of specialized words or phrases unique to the career and industry.
**3.5A** Utilizes computation, both manually and electronically, in adding, subtracting, multiplying, and dividing of whole numbers, fractions, decimals, and percents.
**3.5B** Chooses the right mathematical method or formula to solve a problem.
**3.5C** Performs math operations accurately to complete classroom and lab tasks.
**3.6A** Demonstrates an understanding of scientific principles critical to the course.
**3.6B** Applies scientific principles and technology to solve problems and complete tasks.
**3.6C** Demonstrates knowledge of the scientific method (e.g., identifies the problem, collects information, forms opinions, and draws conclusions).
**3.7A** Uses basic computer hardware (e.g., PC's, printers) and software to perform tasks as required for the course work.

**3.7B** Demonstrates understanding of capabilities of computers and common computer terminology (e.g., program, operating system).
**3.7C** Applies the appropriate technical solution to complete tasks.
**3.7D** Inputs data and information accurately for the course requirements.
**3.8A** Researches and recognizes green trends in career area and industry.
**3.8B** Examines current environmentally-friendly trends.
**3.8C** Applies sustainability practices by understanding processes that are non-polluting, conserving of energy and natural resources, and economically efficient.

## SAMPLE PERFORMANCE TASKS

- Examine and compile different learning styles for portfolios.
- Create calendars containing all activities and obligations for one month. Discuss how to handle conflicting or competing obligations then complete daily and weekly plans showing tasks, priorities, and scheduling.
- Complete self-assessments of study habits.
- Compute precise and exact measurements.
- Explore study strategies for different subjects and tasks, then, analyze two homework assignments and select the best strategies for completing them.
- Create "life maps" showing necessary steps or "landmarks" along the path to personal, financial, educational, and career goals.
- Take notes during counselor classroom visits and work in small groups to create flow charts of the path options.
- Brainstorm ethics that lead to success, then, rate individually in these areas. Work together to suggest strategies for overcoming the weaknesses identified (own and partners' self-assessments) then share with the class the strategies developed.
- Research the Internet and other resources to collect and analyze data concerning climate change.
- Keep a data file of alternative energy sources and the sources' impact on the environment.
- Develop a recycling project at home or for the school environment.

## INTEGRATION LINKAGES

SkillsUSA, Professional Development Program; SkillsUSA; Communications and Writing Skills; Teambuilding Skills; Research; Language Arts; Sociology; Psychology; Math; English; Social Studies; Problem Solving; Interpersonal Skills; Employability Skills; Critical-Thinking Skills; Secretary's Commission on Achieving Necessary Skills (SCANS); Chamber of Commerce; Colleges; Universities; Technology Centers; Secretary's Commission on Achieving Necessary Skills (SCANS)

## ADVANCED DRAFTING & DESIGN

### STANDARD 4.0

Students will create and print two- and three-dimensional scale drawings using software programs.

### LEARNING EXPECTATIONS

The student will:

**4.1** Create and print two-dimensional scale drawings.
**4.2** Create and print drawings of three-dimensional objects including parallel extrusion, perspective extrusion, and three-dimensional isometrics.
**4.3** Create and print engineering drawings of complex objects requiring multiple sectional views.

### PERFORMANCE INDICATORS: EVIDENCE STANDARD IS MET

The student:

**4.1A** Represents location and size of all entities in the drawing.
**4.1B** Uses dimension information in the drawing.
**4.1C** Uses symbol libraries in the drawing where available and appropriate.
**4.1D** Demonstrates layer structure to maximize the drawing's utility.
**4.2A** Uses the appropriate extrusion technique to achieve the intended purpose of three-dimensional object drawing.
**4.2B** Portrays isometric entities with appropriate skew angles.
**4.3A** Combines plane and three-dimensional representations along with appropriate cross-sectional drawings to represent interior detail.
**4.3B** Uses dimension information in the drawing.
**4.3C** Indicates location of cross sections.

### SAMPLE PERFORMANCE TASKS

Students can complete the following drawing projects:

- Complete a plan drawing of an object, school, house, or business.
- Complete a solid-object drawing of the exterior details of a computer monitor.
- Create a three-dimensional drawing of a student or teacher desk.
- Create a three-dimensional drawing using extrusion of a spur gear.
- Complete a project to draw a snap ring, motor shaft, and motor.
- Complete a project to draw an assembly and exploded view, e.g., a belt tightener.
- Complete a wall section through a building in various locations.
- Complete a three-dimensional view of a kitchen or bath.

## INTEGRATION/LINKAGES

National Council for Advance Manufacturing (NACFAM), Manufacturing Skill Standards Council (MSSC). What *Manufacturing Workers Need to Know and Be Able to Do: National Voluntary Skill Standards for Advanced High Performance Manufacturing*, A Blueprint for Workforce Excellence; International Technology Education Association, Standards for Technological Literacy: Content for the Study of Technology; Manufacturing Skill Standards Council, 2001. Project Lead the Way curriculum; Mathematics; Occupation Safety and Health Administration (OSHA)

## ADVANCED DRAFTING & DESIGN

### STANDARD 5.0

Students will apply dimensions and tolerances as per ANSI standards to components of a drawing to assure a working fit between components.

### LEARNING EXPECTATIONS

The student will:

**5.1** Determine the appropriate tolerances for each dimension in a drawing, including assembly, operational, and cost criteria for structures and mechanisms.
**5.2** Include global tolerances in the drawing title block when appropriate.
**5.3** Include explicit tolerances on a drawing's dimensions when appropriate.

### PERFORMANCE INDICATORS: EVIDENCE STANDARD IS MET

The student:

**5.1A** Maintains a portfolio of notes, calculations, and reasoning to defend their choice of dimensions and tolerances shown on drawings.
**5.1B** Explains the intended assembly operations for structures and mechanisms.
**5.1C** Explains the operation of mechanisms and the impact of tolerances on that operation.
**5.1D** Explains the cost impact of their choice of tolerances.
**5.2A** Identifies when the use of global tolerances is applicable and appropriate.
**5.2B** Inserts a global tolerance in the title block of their drawing.
**5.3A** Identifies when the use of explicit tolerances is applicable and appropriate.
**5.3B** Inserts explicit tolerances on individual dimensions when applicable.

### SAMPLE PERFORMANCE TASKS

Students can complete the following drawing projects:

- Complete a project to design a bookcase to given specifications, to be assembled by the end user.
- Complete a project to draw an assembly and exploded view, e.g., a belt tightener.
- Complete a project to design and draw a steel structure including bolted joints.
- Complete a project to design and draw a belt-drive with two stages of speed reduction, employing both pillow block and flange-mount bearings.

### INTEGRATION/LINKAGES

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## ADVANCED DRAFTING & DESIGN

### STANDARD 6.0

Students will research and apply professional standards of a specific discipline to increase their area of knowledge for the drafting and design profession.

### LEARNING EXPECTATIONS

The student will:

**6.1** Create a research project based on different areas of the drafting and design industry.
**6.2** Create a detailed presentation based on one specific area from the research.
**6.3** Write a professional proposal for a specific project based on the student's area of interest.

### PERFORMANCE INDICATORS: EVIDENCE STANDARD IS MET

The student:

**6.1A** Applies research techniques to investigate professions within the drafting and design industry.
**6.1B** Uses this information to create a presentation based on his/her research.
**6.2A** Applies research techniques to investigate one specific area within the drafting and design industry to gain detailed knowledge of that specific area.
**6.2B** Demonstrates knowledge of the student's chosen area.
**6.3** Writes a detailed and professional style proposal to apply the professional standards of a discipline specific area for the student's final project.

### SAMPLE PERFORMANCE TASKS

Students can complete the following projects:

- Present, using varying techniques, the research information compiled.
- Write a research paper on the specific area.
- Create a graphic presentation on the specific area.

### INTEGRATION/LINKAGES

National Council for Advance Manufacturing (NACFAM), Manufacturing Skill Standards Council (MSSC). What *Manufacturing Workers Need to Know and Be Able to Do: National Voluntary Skill Standards for Advanced High Performance Manufacturing*, A Blueprint for Workforce Excellence; International Technology Education Association, Standards for Technological Literacy: Content for the Study of Technology; Manufacturing Skill Standards Council, 2001. Project Lead the Way curriculum; Mathematics; Occupation Safety and Health Administration (OSHA)

## ADVANCED DRAFTING & DESIGN

### STANDARD 7.0

Students will apply professional standards to specific real-life projects in related mechanical and/or architectural applications.

### LEARNING EXPECTATIONS

The student will:

**7.1** Create a design project based on different areas of the drafting and design industry.
**7.2** Create detailed working drawings based on professional standards.
**7.3** Present design and working drawings to a group of peers and/or members of the profession.

### PERFORMANCE INDICATORS: EVIDENCE STANDARD IS MET

The student:

**7.1** Applies professional design standards to complete a working design of a project.
**7.2** Applies professional drawing standards and techniques to complete a set of working drawings.
**7.3** Gives a prepared presentation of design and drawings.

### SAMPLE PERFORMANCE TASKS

Students can complete the following projects:

- Design sketches to come up with a workable design for a specific project.
- Plan and schedule the completion of working drawings.
- Create a graphic presentation on the design and finished project.

### INTEGRATION/LINKAGES

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## ADVANCED DRAFTING & DESIGN

### STANDARD 8.0

Students will extract information from a technical drawing to create a bill of materials and/or schedules.

### LEARNING EXPECTATIONS

The student will:

**8.1** Identify the available form(s) of each raw material required for the assembly and make defendable recommendations.
**8.2** Make a list of each type of raw material with all required specifications for an assembly.
**8.3** Make a list and specifications for finished-good components required of an assembly.
**8.4** Identify allowable alternates or substitutions (if any) on the bill of materials and/or schedules.

### PERFORMANCE INDICATORS: EVIDENCE STANDARD IS MET

The student:

**8.1A** Maintains a portfolio of notes, calculations, and reasoning to describe the materials required for the assembly.
**8.1B** Maintains a portfolio of notes, calculations, and reasoning to describe the recommended purchase form of materials for the assembly, considering criteria such as minimizing scrap, minimizing cost, delivery schedule, and preferred sources.
**8.2A** Identifies each raw material needed for the assembly along with pertinent specifications.
**8.2B** Makes a list of raw material purchase items, including specifications, allowed vendors and shipping restrictions.
**8.3A** Identifies each finished-goods component needed for the assembly along with pertinent specifications.
**8.3B** Makes a list of finished-good component items, including specifications, allowed vendors, and shipping restrictions.
**8.4A** Completes the bill of materials, including approved alternate materials, components, and vendors.
**8.4B** Includes the designated authority for approval of other changes to the bill of materials.

### SAMPLE PERFORMANCE TASKS

Students can complete the following projects:

- For each drawing project previously assigned, complete a bill of materials.

### INTEGRATION/LINKAGES

National Council for Advance Manufacturing (NACFAM), Manufacturing Skill Standards Council (MSSC). What *Manufacturing Workers Need to Know and Be Able to Do: National Voluntary Skill Standards for Advanced High Performance Manufacturing*, A Blueprint for Workforce Excellence; International Technology Education Association, Standards for Technological Literacy: Content for the Study of Technology; Manufacturing Skill Standards Council, 2001. Project Lead the Way curriculum; Mathematics; Occupation Safety and Health Administration (OSHA)