

# Advanced Engineering CAD

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## 1A1

### 1.0.1 Nature of Technology

Students develop an understanding of technology, its characteristics, scope, core concepts\* and relationships between technologies and other fields.

*\*The core concepts of technology include systems, resources, requirements, optimization and tradeoffs, processes and controls.*

**Technology Diffusion** Synthesize information, evaluate and make decisions about technologies.

**1A1** List and describe factors that may influence the development of technology.

## 1A2

### 1.0.2 Nature of Technology

Students develop an understanding of technology, its characteristics, scope, core concepts\* and relationships between technologies and other fields.

*\*The core concepts of technology include systems, resources, requirements, optimization and tradeoffs, processes and controls.*

**Goal-directed Research** Synthesize information, evaluate and make decisions about technologies.

**1A2** Describe goal-directed research, define invention and innovation, and explain the relationship among them.

## 1A3

### 1.0.3 Nature of Technology

Students develop an understanding of technology, its characteristics, scope, core concepts\* and relationships between technologies and other fields.

*\*The core concepts of technology include systems, resources, requirements, optimization and tradeoffs, processes and controls.*

**Commercialization of Technology** Synthesize information, evaluate and make decisions about technologies.

**1A3** Make informed choices among technology systems, resources and services.

## 1B1

### 1.0.4 Nature of Technology

Students develop an understanding of technology, its characteristics, scope, core concepts\* and relationships between technologies and other fields.

*\*The core concepts of technology include systems, resources, requirements, optimization and tradeoffs, processes and controls.*

**Optimization and Trade-offs** Apply technological knowledge in decision-making.

**1B1** Cite examples showing how the failure of system components contributes to the instability of a technological system (e.g., if the fuel pump in an automobile malfunctions, the entire system will not work properly; or if a computer hard drive fails, the computer system will not work properly).

## 1C1

### 1.0.5 Nature of Technology

Students develop an understanding of technology, its characteristics, scope, core concepts<sup>1</sup> and relationships between technologies and other fields.

*\*The core concepts of technology include systems, resources, requirements, optimization and tradeoffs, processes and controls.*

**Technology Transfer** Examine the synergy between and among technologies and other fields of study when solving technological problems.

**1C1** Describe how technology transfer occurs when an innovation in one setting is applied in a different setting.

## 1C2

### 1.0.6 Nature of Technology

Students develop an understanding of technology, its characteristics, scope, core concepts\* and relationships between technologies and other fields.

*\*The core concepts of technology include systems, resources, requirements, optimization and tradeoffs, processes and controls.*

**Innovation and Invention** Examine the synergy between and among technologies and other fields of study when solving technological problems.

**1C2** Describe how technologies are, or can be, combined (e.g., a computer-controlled surgical laser scalpel represents the combination of physical, information and bio-related technology).

1C3

**1.0.7 Nature of Technology**

Students develop an understanding of technology, its characteristics, scope, core concepts\* and relationships between technologies and other fields.

*\*The core concepts of technology include systems, resources, requirements, optimization and tradeoffs, processes and controls.*

**Innovation and Invention** Examine the synergy between and among technologies and other fields of study when solving technological problems.

**1C3** Define examples of how technological progress is integral to the advancement of science, mathematics and other fields of study.

1C3

**1.0.8 Nature of Technology**

Students develop an understanding of technology, its characteristics, scope, core concepts\* and relationships between technologies and other fields.

*\*The core concepts of technology include systems, resources, requirements, optimization and tradeoffs, processes and controls.*

**Innovation and Invention** Examine the synergy between and among technologies and other fields of study when solving technological problems.

**1C3** Predict changes in society as a result of continued technological progress and defend the rationale.

2A1

**1.0.9 Technology and Society Interaction**

Students recognize interactions among society, the environment and technology, and understand technology's relationship with history. Consideration of these concepts forms a foundation for engaging in responsible and ethical use of technology.

**Technology and Citizenship** Interpret and practice responsible citizenship relative to technology.

**2A1** Explain how making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects.

**2B1**

**1.0.10 Technology and Society Interaction**

Students recognize interactions among society, the environment and technology, and understand technology's relationship with history. Consideration of these concepts forms a foundation for engaging in responsible and ethical use of technology.

**Technology and the Environment** Demonstrate the relationship among people, technology and the environment.

**2B1** Understand that humans can devise technologies to conserve water, soil and energy through such techniques as reusing, reducing and recycling.

**2C1**

**1.0.11 Technology and Society Interaction**

Students recognize interactions among society, the environment and technology, and understand technology's relationship with history. Consideration of these concepts forms a foundation for engaging in responsible and ethical use of technology.

**Technology and History** Interpret and evaluate the influence of technology throughout history, and predict its impact on the future.

**2C1** Describe how some technological development has been evolutionary, the result of a series of refinements to basic inventions or innovations over time.

**2C2**

**1.0.12 Technology and Society Interaction**

Students recognize interactions among society, the environment and technology, and understand technology's relationship with history. Consideration of these concepts forms a foundation for engaging in responsible and ethical use of technology.

**Technology and History** Interpret and evaluate the influence of technology throughout history, and predict its impact on the future.

**2C2** Select a technology or tool and predict how it will change in the future.

## 2D1

### 1.0.13 Technology and Society Interaction

Students recognize interactions among society, the environment and technology, and understand technology's relationship with history. Consideration of these concepts forms a foundation for engaging in responsible and ethical use of technology.

**Technology and Ethics** Analyze ethical and legal technology issues and formulate solutions and strategies that foster responsible technology usage.

**2D1** Practice responsible usage of technologies (e.g., download legally, install licensed software, adhere to copyright restrictions).

## 2D4

### 1.0.14 Technology and Society Interaction

Students recognize interactions among society, the environment and technology, and understand technology's relationship with history. Consideration of these concepts forms a foundation for engaging in responsible and ethical use of technology.

**Technology and Ethics** Analyze ethical and legal technology issues and formulate solutions and strategies that foster responsible technology usage.

**2D4** Practice responsible and ethical usage of technology.

## 2E2

### 1.0.15 Technology and Society Interaction

Students recognize interactions among society, the environment and technology, and understand technology's relationship with history. Consideration of these concepts forms a foundation for engaging in responsible **and** ethical use of technology.

**Technology Assessment** Forecast the impact of technological products and systems.

**2E2** Select a technology that has had national impact and describe its impact.

**2E3**

**1.0.16 Technology and Society Interaction**

Students recognize interactions among society, the environment and technology, and understand technology's relationship with history. Consideration of these concepts forms a foundation for engaging in responsible and ethical use of technology.

**Technology Assessment** Forecast the impact of technological products and systems.

**2E3** Compare and contrast the past, present and future developments of a technological system.

**3A3**

**1.0.17 Technology for Productivity Applications**

Students learn the operations of technology through the usage of technology and productivity tools.

**Problem-solving** Integrate conceptual knowledge of technology systems in determining practical applications for learning and technical problem-solving.

**3A3** Apply strategies for identifying and solving routine hardware and software problems that occur during everyday use.

**3A3**

**1.0.18 Technology for Productivity Applications**

Students learn the operations of technology through the usage of technology and productivity tools.

**Problem-solving** Integrate conceptual knowledge of technology systems in determining practical applications for learning and technical problem-solving.

**3A3** Apply strategies for identifying and solving routine hardware and software problems that occur during everyday use.

## 3B1

### 1.0.19 Technology for Productivity Applications

Students learn the operations of technology through the usage of technology and productivity tools.

**Knowledge Generation** Identify, select and apply appropriate technology tools and resources to produce creative works and to construct technology-enhanced models.

**3B1** Assimilate productivity and technological tools into all aspects of solving problems and managing personal information and communications.

## 3B1

### 1.0.20 Technology for Productivity Applications

Students learn the operations of technology through the usage of technology and productivity tools.

**Understanding Operations** Identify, select and apply appropriate technology tools and resources to produce creative works and to construct technology-enhanced models.

**3B1** Identify and use input and output devices to operate and interact with computers and multimedia technology resources (e.g., digital video camera, mobile cameras-a camera on a robot base, like a Mars rover, how to connect analog equipment to digital equipment).

## 3B2

### 1.0.21 Technology for Productivity Applications

Students learn the operations of technology through the usage of technology and productivity tools.

**Knowledge Generation** Identify, select and apply appropriate technology tools and resources to produce creative works and to construct technology-enhanced models.

**3B2** Use technology tools to model complex systems of information to improve the communication of and access to the information (e.g., modeling physics principles, graphic/geographic information system, weather modeling).

## 3B2

### 1.0.22 Technology for Productivity Applications

Students learn the operations of technology through the usage of technology and productivity tools.

**Productivity Tools** Identify, select and apply appropriate technology tools and resources to produce creative works and to construct technology-enhanced models.

**3B2** Demonstrate proficiency in all productivity tools (e.g., word processing, spreadsheet, database, desktop publishing).

## 3B2

### 1.0.23 Technology for Productivity Applications

Students learn the operations of technology through the usage of technology and productivity tools.

**Communication Tools** Identify, select and apply appropriate technology tools and resources to produce creative works and to construct technology-enhanced models.

**3B2** Use equipment related to computer and multimedia technology imaging (e.g., digitalization, optical character recognition, and scanning, computerized microscopes).

## 3B3

### 1.0.24 Technology for Productivity Applications

Students learn the operations of technology through the usage of technology and productivity tools.

**Problem-solving** Identify, select and apply appropriate technology tools and resources to produce creative works and to construct technology-enhanced models.

**3B3** Identify/recognize state-of-the-art technology tools for solving problems and managing personal/professional information.

## 4A4

### **1.0.25 Technology and Communication Applications**

Students use an array of technologies and apply design concepts to communicate with multiple audiences, acquire and disseminate information and enhance learning.

**Evaluation** Apply appropriate communication design principles in published and presented projects.

**4A4** Assess the accuracy of the communication product.

## 4B1

### **1.0.26 Technology and Communication Applications**

Students use an array of technologies and apply design concepts to communicate with multiple audiences, acquire and disseminate information and enhance learning.

**Electronic Communications** Create, publish and present information, utilizing formats appropriate to the content and audience.

**4B1** Archive communication products in appropriate electronic forms (e.g., store electronic publications so that they may be accessed when needed).

## 4B2

### **1.0.27 Technology and Communication Applications**

Students use an array of technologies and apply design concepts to communicate with multiple audiences, acquire and disseminate information and enhance learning.

**Use of Communications** Create, publish and present information, utilizing formats appropriate to the content and audience.

**4B2** Use technology to publish information in electronic form (e.g., Web, multimedia, digital video, electronic portfolio).

## 6A1

### 1.0.28 Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

**Design Process** Identify and produce a product or system using a design process, evaluate the final solution and communicate the findings.

**6A1** Explain and apply the methods and tools of inventive problem-solving to develop and produce a product or system.

## 6A3

### 1.0.29 Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

**Technical Contradictions** Identify and produce a product or system using a design process, evaluate the final solution and communicate the findings.

**6A3** Identify the conceptual and technical principles that underpin design processes (e.g., analyze characteristics of technical systems that affect performance and identify principles that resolve design contradictions).

## 6A4

### 1.0.30 Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

**Requirements** Identify and produce a product or system using a design process, evaluate the final solution and communicate the findings.

**6A4** Identify the elements of quality in a product/system (e.g., tolerances, fit, finish, function, form (aesthetics), repeatability, durability, material).

## 6A5

### 1.0.31 Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

**Optimization and Trade-offs** Identify and produce a product or system using a design process, evaluate the final solution and communicate the findings.

**6A5** Explain that design problems are seldom presented in a clearly defined form (e.g., problems often involve competing constituencies, undiscovered constraints and unidentified regulations).

## 6A6

### 1.0.32 Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

**Technical Problem-solving** Identify and produce a product or system using a design process, evaluate the final solution and communicate the findings.

**6A6** Brainstorm solutions to problems using common brainstorming techniques (e.g., select a leader, select a recorder, generate ideas, discuss and add-on to ideas of others and recognize all ideas are welcome).

## 6A7

### 1.0.33 Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

**Technical Communication** Identify and produce a product or system using a design process, evaluate the final solution and communicate the findings.

**6A7** Demonstrate knowledge of pictorial and multi-view CAD drawings (e.g., orthographic projection, isometric, oblique, perspective using proper techniques).

## 6A8

### 1.0.34 Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

**Technical Communication** Identify and produce a product or system using a design process, evaluate the final solution and communicate the findings.

**6A8** Recognize that patent, trademark and copyright laws protect technological ideas and intellectual property.

## 6A9

### 1.0.35 Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

**Understanding Technological Systems** Identify and produce a product or system using a design process, evaluate the final solution and communicate the findings.

**6A9** Describe how the technological systems of manufacturing, construction, information and communication, energy and power, transportation, medical, and agricultural, and related biotechnologies can be used to solve practical problems.

## 6B1

### 1.0.36 Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

**Design Process** Recognize the role of teamwork in engineering design and of prototyping in the design process.

**6B1** Explain how established design principles are used to evaluate existing designs, collect data and guide the design process (e.g., design principles include flexibility, unity, emphasis, balance, function and proportion).

## 6B2

### 1.0.37 Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

**Design Process** Recognize the role of teamwork in engineering design and of prototyping in the design process.

**6B2** Explain how a prototype is a working model used to test a design concept by making actual observations and necessary adjustments.

## 6B3

### 1.0.38 Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

**Design Process** Recognize the role of teamwork in engineering design and of prototyping in the design process.

**6B3** Create a model of a design solution to an engineering problem (e.g., virtual, physical, graphic or mathematical model).

## 6B4

### 1.0.39 Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

**Requirements** Recognize the role of teamwork in engineering design and of prototyping in the design process.

**6B4** Identify the factors that must be taken into account in the process of engineering design (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, and human factors in engineering, such as ergonomics).

## 6B5

### 1.0.40 Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

**Design Team Collaboration** Recognize the role of teamwork in engineering design and of prototyping in the design process.

**6B5** Describe how engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.

## 6B6

### 1.0.41 Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

**Design Team Collaboration** Recognize the role of teamwork in engineering design and of prototyping in the design process.

**6B6** Describe the importance of teamwork, leadership, integrity, honesty, work habits and organizational skills of members during the design process.

## 6B7

### 1.0.42 Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

**Technical Careers** Recognize the role of teamwork in engineering design and of prototyping in the design process.

**6B7** Explain the different engineering disciplines and how they relate to the major technological systems (e.g., mechanical-manufacturing, audiocommunication, civilconstruction).

## 6C2

### 1.0.43 Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

**Redesign** Understand and apply research, development and experimentation to problem-solving.

**6C2** Research previous solutions to a technological problem and redesign an alternative solution.

## 6C3

### 1.0.44 Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

**Reverse Engineering** Understand and apply research, development and experimentation to problem-solving.

**6C3** Describe and demonstrate the reverse engineering process in problem-solving.

## 6C4

### 1.0.45 Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

**Technical Communication** Understand and apply research, development and experimentation to problem-solving.

**6C4** Use and maintain technical drawing/design tools in order to create a variety of drawings and illustrations (e.g., instruments, equipment, materials, computer-aided design software, hardware and systems).

## 6C5

### 1.0.46 Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

**Technical Communication** Understand and apply research, development and experimentation to problem-solving.

**6C5** Use computers, calculators, instruments and devices to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate to group members (e.g., CAD computer-aided design, software, library resources, the Internet, word processing, CBL/calculator based labs, laser measuring tools and spreadsheet software).

## 7B2

### 1.0.47 Designed World

Students understand how the physical, informational and bio-related technological systems of the designed world are brought about by the design process. Critical to this will be students' understanding of their role in the designed world: its processes, products, standards, services, history, future, impact, issues and career connections.

**System Management** Classify, demonstrate, examine and appraise transportation technologies.

**7B2** Describe the vital role transportation plays in the operation of other technologies, such as manufacturing, construction, communication, health and safety, and agriculture (e.g., subsystems of aviation, rail transportation, water transportation, pedestrian walkways, roadways).

## 7B3

### 1.0.48 Designed World

Students understand how the physical, informational and bio-related technological systems of the designed world are brought about by the design process. Critical to this will be students' understanding of their role in the designed world: its processes, products, standards, services, history, future, impact, issues and career connections.

**Safety** Classify, demonstrate, examine and appraise transportation technologies.

**7B3** Identify and apply appropriate safety measures when working with transportation technologies.

## 7B4

### 1.0.49 Designed World

Students understand how the physical, informational and bio-related technological systems of the designed world are brought about by the design process. Critical to this will be students' understanding of their role in the designed world: its processes, products, standards, services, history, future, impact, issues and career connections.

**Use and Maintain Technological Systems** Classify, demonstrate, examine and appraise transportation technologies.

**7B4** Employ transportation technologies to resolve practical problems (e.g., getting students to athletic events).

## 7C2

### 1.0.50 Designed World

Students understand how the physical, informational and bio-related technological systems of the designed world are brought about by the design process. Critical to this will be students' understanding of their role in the designed world: its processes, products, standards, services, history, future, impact, issues and career connections.

**System Management** Classify, demonstrate, examine and appraise manufacturing technologies.

**7C2** Describe the factors that influence the cost of producing technological products and systems in manufacturing technologies (e.g., materials, labor, energy, time, location).

## 7C2

### 1.0.51 Designed World

Students understand how the physical, informational and bio-related technological systems of the designed world are brought about by the design process. Critical to this will be students' understanding of their role in the designed world: its processes, products, standards, services, history, future, impact, issues and career connections.

**System Management** Classify, demonstrate, examine and appraise manufacturing technologies.

**7C2** Produce a product using the manufacturing system (e.g., customized production, batch production and continuous production) appropriate to the context.

7C3

**1.0.52 Designed World**

Students understand how the physical, informational and bio-related technological systems of the designed world are brought about by the design process. Critical to this will be students' understanding of their role in the designed world: its processes, products, standards, services, history, future, impact, issues and career connections.

**Use and Maintain Technological Systems** Classify, demonstrate, examine and appraise manufacturing technologies.

**7C3** Identify and investigate modern production technology practices and equipment in manufacturing technologies (e.g., just-in-time, lean production, six-sigma, new automation processes, systems, materials, tools).

7C3

**1.0.53 Designed World**

Students understand how the physical, informational and bio-related technological systems of the designed world are brought about by the design process. Critical to this will be students' understanding of their role in the designed world: its processes, products, standards, services, history, future, impact, issues and career connections.

**Safety** Classify, demonstrate, examine and appraise manufacturing technologies.

**7C3** Identify and apply appropriate safety measures when working with manufacturing technologies.

7C5

**1.0.54 Designed World**

Students understand how the physical, informational and bio-related technological systems of the designed world are brought about by the design process. Critical to this will be students' understanding of their role in the designed world: its processes, products, standards, services, history, future, impact, issues and career connections.

**Use and Maintain Technological Systems** Classify, demonstrate, examine and appraise manufacturing technologies.

**7C5** Employ manufacturing technologies to resolve practical problems (e.g., produce a product).

## 7C6

### **1.0.55 Designed World**

Students understand how the physical, informational and bio-related technological systems of the designed world are brought about by the design process. Critical to this will be students' understanding of their role in the designed world: its processes, products, standards, services, history, future, impact, issues and career connections.

**Technology Assessment** Classify, demonstrate, examine and appraise manufacturing technologies.

**7C6** Identify and investigate a variety of technological tools, equipment, machines, materials and technical processes used in manufacturing technologies to manufacture/fabricate products or systems.

## 7C7

### **1.0.56 Designed World**

Students understand how the physical, informational and bio-related technological systems of the designed world are brought about by the design process. Critical to this will be students' understanding of their role in the designed world: its processes, products, standards, services, history, future, impact, issues and career connections.

**Emerging Technology** Classify, demonstrate, examine and appraise manufacturing technologies.

**7C7** Investigate emerging (state-of-the-art) and innovative applications of manufacturing technology.

## 7D3

### **1.0.57 Designed World**

Students understand how the physical, informational and bio-related technological systems of the designed world are brought about by the design process. Critical to this will be students' understanding of their role in the designed world: its processes, products, standards, services, history, future, impact, issues and career connections.

**Safety** Classify, demonstrate, examine and appraise construction technologies.

**7D3** Identify and apply appropriate safety measures when working with construction technologies.

## 7D4

### 1.0.58 Designed World

Students understand how the physical, informational and bio-related technological systems of the designed world are brought about by the design process. Critical to this will be students' understanding of their role in the designed world: its processes, products, standards, services, history, future, impact, issues and career connections.

**Engineering Practice** Classify, demonstrate, examine and appraise construction technologies.

**7D4** Distinguish among the different forces acting upon structural components (e.g., tension, compression, shear and torsion).

## 7D5

### 1.0.59 Designed World

Students understand how the physical, informational and bio-related technological systems of the designed world are brought about by the design process. Critical to this will be students' understanding of their role in the designed world: its processes, products, standards, services, history, future, impact, issues and career connections.

**Use and Maintain Technological Systems** Classify, demonstrate, examine and appraise construction technologies.

**7D5** Identify and use a variety of technological tools, equipment, machines, materials and technical processes used in construction technologies to build/construct products or systems.

## 7D7

### 1.0.60 Designed World

Students understand how the physical, informational and bio-related technological systems of the designed world are brought about by the design process. Critical to this will be students' understanding of their role in the designed world: its processes, products, standards, services, history, future, impact, issues and career connections.

**Design Applications** Classify, demonstrate, examine and appraise construction technologies.

**7D7** Differentiate the factors that affect the design and building of structures (e.g., material availability, zoning laws, the need for riparian buffer, building codes and professional standards).