

# Engineering Design and Presentation I

Subject: Career and Technical Education

Grade: 10

Expectations: 63

Breakouts: 182

## (a) Introduction.

1. Career and technical education instruction provides content aligned with challenging academic standards, industry-relevant technical knowledge, and college and career readiness skills for students to further their education and succeed in current and emerging professions.
2. The Science, Technology, Engineering, and Mathematics (STEM) Career Cluster focuses on planning, managing, and providing scientific research and professional and technical services, including laboratory and testing services, and research and development services.
3. Students enrolled in Engineering Design and Presentation I will demonstrate knowledge and skills of the design process as it applies to engineering fields and project management using multiple software applications and tools necessary to produce and present working drawings, solid model renderings, and prototypes. Through implementation of the design process, students will transfer advanced academic skills to component designs. Additionally, students will explore career opportunities in engineering, technology, and drafting and what is required to gain and maintain employment in these areas.
4. Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
5. Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

## (b) Knowledge and Skills Statements

- (1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:
  - (A) demonstrate knowledge of how to dress appropriately, speak politely, and conduct oneself in a manner appropriate for the profession and work site;
    - (i) demonstrate knowledge of how to dress appropriately for the profession
    - (ii) demonstrate knowledge of how to speak politely for the profession
    - (iii) demonstrate knowledge of how to conduct oneself in a manner appropriate for the profession
    - (iv) demonstrate knowledge of how to dress appropriately for the work site
    - (v) demonstrate knowledge of how to speak politely for the work site
    - (vi) demonstrate knowledge of how to conduct oneself in a manner appropriate for the work site

- (B) cooperate, contribute, and collaborate as a member of a group to attain agreement and achieve a collective outcome;
  - (i) cooperate as a member of a group to attain agreement
  - (ii) cooperate as a member of a group to achieve a collective outcome
  - (iii) contribute as a member of a group to attain agreement
  - (iv) contribute as a member of a group to achieve a collective outcome
  - (v) collaborate as a member of a group to attain agreement
  - (vi) collaborate as a member of a group to achieve a collective outcome
- (C) present written and oral communication in a clear, concise, and effective manner, including explaining and justifying actions;
  - (i) present written communication in a clear manner, including explaining actions
  - (ii) present written communication in a concise manner, including explaining actions
  - (iii) present written communication in [an] effective manner, including explaining actions
  - (iv) present written communication in a clear manner, including justifying actions
  - (v) present written communication in a concise manner, including justifying actions
  - (vi) present written communication in [an] effective manner, including justifying actions
  - (vii) present oral communication in a clear manner, including explaining actions
  - (viii) present oral communication in a concise manner, including explaining actions
  - (ix) present oral communication in [an] effective manner, including explaining actions
  - (x) present oral communication in a clear manner, including justifying actions
  - (xi) present oral communication in a concise manner, including justifying actions
  - (xii) present oral communication in [an] effective manner, including justifying actions
- (D) use time-management skills in prioritizing tasks, following schedules, and tending to goal-relevant activities in a way that optimizes efficiency and results; and
  - (i) use time-management skills in prioritizing tasks in a way that optimizes efficiency
  - (ii) use time-management skills in following schedules in a way that optimizes efficiency
  - (iii) use time-management skills in tending to goal-relevant activities in a way that optimizes efficiency
  - (iv) use time-management skills in prioritizing tasks in a way that optimizes results
  - (v) use time-management skills in following schedules in a way that optimizes results
  - (vi) use time-management skills in tending to goal-relevant activities in a way that optimizes results

(E) demonstrate punctuality, dependability, reliability, and responsibility in reporting for duty and performing assigned tasks as directed.

- (i) demonstrate punctuality in reporting for duty
- (ii) demonstrate punctuality in performing assigned tasks as directed
- (iii) demonstrate dependability in reporting for duty
- (iv) demonstrate dependability in performing assigned tasks as directed
- (v) demonstrate reliability in reporting for duty
- (vi) demonstrate reliability in performing assigned tasks as directed
- (vii) demonstrate responsibility in reporting for duty
- (viii) demonstrate responsibility in performing assigned tasks as directed

(2) The student gains knowledge of and demonstrates the skills necessary for success in the workplace. The student is expected to:

(A) distinguish between an engineering technician, engineering technologist, and engineer;

- (i) distinguish between an engineering technician, engineering technologist, and engineer

(B) identify employment and career opportunities in engineering and describe the educational requirements for each;

- (i) identify employment opportunities in engineering
- (ii) identify career opportunities in engineering
- (iii) describe the educational requirements for [employment opportunities in engineering]
- (iv) describe the educational requirements for [career opportunities in engineering]

(C) investigate and describe the requirements of industry-based certifications in engineering;

- (i) investigate the requirements of industry-based certifications in engineering
- (ii) describe the requirements of industry-based certifications in engineering

(D) demonstrate the principles of teamwork related to engineering and technology;

- (i) demonstrate the principles of teamwork related to engineering
- (ii) demonstrate the principles of teamwork related to technology

(E) research and describe governmental regulations, including health and safety;

- (i) research governmental regulations, including health
- (ii) research governmental regulations, including safety
- (iii) describe governmental regulations, including health
- (iv) describe governmental regulations, including safety

(F) analyze ethical issues related to engineering and technology and incorporate proper ethics in submitted projects;

- (i) analyze ethical issues related to engineering
- (ii) analyze ethical issues related to technology
- (iii) incorporate proper ethics in submitted projects

- (G) demonstrate respect for diversity in the workplace;
  - (i) demonstrate respect for diversity in the workplace
- (H) identify consequences relating to discrimination, harassment, and inequality;
  - (i) identify consequences relating to discrimination
  - (ii) identify consequences relating to harassment
  - (iii) identify consequences relating to inequality
- (I) demonstrate effective oral and written communication skills using a variety of software applications and media;  
and
  - (i) demonstrate effective oral communication skills using a variety of software applications
  - (ii) demonstrate effective oral communication skills using a variety of media
  - (iii) demonstrate effective written communication skills using a variety of software applications
  - (iv) demonstrate effective written communication skills using a variety of media
- (J) investigate and present on career preparation learning experiences, including job shadowing, mentoring, and apprenticeship training.
  - (i) investigate career preparation learning experiences, including job shadowing
  - (ii) investigate career preparation learning experiences, including mentoring
  - (iii) investigate career preparation learning experiences, including apprenticeship training
  - (iv) present on career preparation learning experiences, including job shadowing
  - (v) present on career preparation learning experiences, including mentoring
  - (vi) present on career preparation learning experiences, including apprenticeship training

(3) The student participates in team projects in various roles. The student is expected to:

- (A) describe the various roles on an engineering team and discuss how teams function;
  - (i) describe the various roles on an engineering team
  - (ii) discuss how [engineering] teams function
- (B) apply teamwork to solve problems; and
  - (i) apply teamwork to solve problems
- (C) serve as both a team leader and member and demonstrate appropriate attitudes while participating in team projects.
  - (i) serve as a team leader
  - (ii) serve as a team member
  - (iii) demonstrate appropriate attitudes while participating in team projects

(4) The student develops skills for managing a project. The student is expected to:

- (A) implement project management methodologies, including initiating, planning, executing, monitoring and controlling, and closing a project;
    - (i) implement project management methodologies, including initiating a project
    - (ii) implement project management methodologies, including planning a project
    - (iii) implement project management methodologies, including executing a project
    - (iv) implement project management methodologies, including monitoring and controlling a project
    - (v) implement project management methodologies, including closing a project
  - (B) develop a project schedule and complete work according to established criteria;
    - (i) develop a project schedule
    - (ii) complete work according to established criteria
  - (C) participate in the organization and operation of a real or simulated engineering project; and
    - (i) participate in the organization of a real or simulated engineering project
    - (ii) participate in the operation of a real or simulated engineering project
  - (D) develop a plan for production of an individual product.
    - (i) develop a plan for production of an individual product
- (5) The student practices safe and proper work habits. The student is expected to:
- (A) master relevant safety tests;
    - (i) master relevant safety tests
  - (B) comply with safety guidelines as described in various manuals, instructions, and regulations;
    - (i) comply with safety guidelines as described in various manuals
    - (ii) comply with safety guidelines as described in various instructions
    - (iii) comply with safety guidelines as described in various regulations
  - (C) identify and classify hazardous materials and wastes according to Occupational Safety and Health Administration (OSHA) regulations;
    - (i) identify hazardous materials according to Occupational Safety and Health Administration (OSHA) regulations
    - (ii) identify hazardous wastes according to Occupational Safety and Health Administration (OSHA) regulations
    - (iii) classify hazardous material according to Occupational Safety and Health Administration (OSHA) regulations
    - (iv) classify hazardous wastes according to Occupational Safety and Health Administration (OSHA) regulations
  - (D) describe the appropriate disposal of hazardous materials and wastes appropriately;
    - (i) describe the appropriate disposal of hazardous materials appropriately
    - (ii) describe the appropriate disposal of hazardous wastes appropriately

- (E) perform maintenance on selected tools, equipment, and machines;
    - (i) perform maintenance on selected tools
    - (ii) perform maintenance on selected equipment
    - (iii) perform maintenance on selected machines
  - (F) handle and store tools and materials correctly; and
    - (i) handle tools correctly
    - (ii) handle materials correctly
    - (iii) store tools correctly
    - (iv) store materials correctly
  - (G) describe the results of negligent or improper maintenance.
    - (i) describe the results of negligent or improper maintenance
- (6) The student applies skills associated with computer-aided drafting and design. The student is expected to:
- (A) use single and multi-view projections;
    - (i) use single-view projections
    - (ii) use multi-view projections
  - (B) use orthographic and pictorial views;
    - (i) use orthographic views
    - (ii) use pictorial views
  - (C) use auxiliary views;
    - (i) use auxiliary views
  - (D) use section views;
    - (i) use section views
  - (E) use advanced construction techniques;
    - (i) use advanced construction techniques
  - (F) prepare and revise annotated multi-dimensional production drawings in computer-aided drafting and design to industry standards;
    - (i) prepare annotated multi-dimensional production drawings in computer-aided drafting and design to industry standards
    - (ii) revise annotated multi-dimensional production drawings in computer-aided drafting and design to industry standards
  - (G) apply best practices for effective file structure and management;
    - (i) apply best practices for effective file structure
    - (ii) apply best practices for effective file management

- (H) use advanced dimensioning techniques;
  - (i) use advanced dimensioning techniques
- (I) construct and use basic 3D parametric drawings; and
  - (i) construct basic 3D parametric drawings
  - (ii) use basic 3D parametric drawings
- (J) develop and use prototype drawings for presentation.
  - (i) develop prototype drawings for presentation
  - (ii) use prototype drawings for presentation

(7) The student uses engineering design methodologies. The student is expected to:

- (A) describe principles of ideation and apply ideation techniques for an engineering project;
  - (i) describe principles of ideation
  - (ii) apply ideation techniques for an engineering project
- (B) demonstrate critical thinking, identify the solution constraints, and make fact-based decisions;
  - (i) demonstrate critical thinking
  - (ii) identify the solution constraints
  - (iii) make fact-based decisions
- (C) develop or improve a product using rational thinking;
  - (i) develop or improve a product using rational thinking
- (D) apply decision-making strategies when developing solutions;
  - (i) apply decision-making strategies when developing solutions
- (E) use an engineering notebook to record prototypes, corrections, and/or mistakes in the design process; and
  - (i) use an engineering notebook to record prototypes in the design process
  - (ii) use an engineering notebook to record corrections in the design process
  - (iii) use an engineering notebook to record mistakes in the design process
- (F) use an engineering notebook or portfolio to record the final design, construction, and manipulation of finished projects.
  - (i) use an engineering notebook or portfolio to record the final design of finished projects
  - (ii) use an engineering notebook or portfolio to record the construction of finished projects
  - (iii) use an engineering notebook or portfolio to record the manipulation of finished projects

(8) The student applies concepts of engineering to specific problems. The student is expected to:

- (A) design components using a variety of technologies;
  - (i) design components using a variety of technologies

- (B) investigate the applications of different types of computer-aided drafting and design software for various engineering problems; and
    - (i) investigate the applications of different types of computer-aided drafting and design software for various engineering problems
  - (C) use multiple software applications for concept presentations.
    - (i) use multiple software applications for concept presentations
- (9) The student designs products using appropriate design processes and techniques. The student is expected to:
- (A) interpret engineering drawings;
    - (i) interpret engineering drawings
  - (B) identify areas where quality, reliability, and safety can be designed into a product;
    - (i) identify areas where quality can be designed into a product
    - (ii) identify areas where reliability can be designed into a product
    - (iii) identify areas where safety can be designed into a product
  - (C) modify a product design to meet a specified need;
    - (i) modify a product design to meet a specified need
  - (D) produce engineering drawings to industry standards; and
    - (i) produce engineering drawings to industry standards
  - (E) describe potential patents and the patenting process.
    - (i) describe potential patents
    - (ii) describe the patenting process
- (10) The student builds a prototype using the appropriate tools, materials, and techniques. The student is expected to:
- (A) identify and describe the steps needed to produce a prototype;
    - (i) identify the steps needed to produce a prototype
    - (ii) describe the steps needed to produce a prototype
  - (B) identify and use appropriate tools, equipment, machines, and materials to produce the prototype; and
    - (i) identify appropriate tools to produce the prototype
    - (ii) identify appropriate equipment to produce the prototype
    - (iii) identify appropriate machines to produce the prototype
    - (iv) identify appropriate materials to produce the prototype
    - (v) use appropriate tools to produce the prototype
    - (vi) use appropriate equipment to produce the prototype
    - (vii) use appropriate machines to produce the prototype
    - (viii) use appropriate materials to produce the prototype



(C) present the prototype using a variety of media.

(i) present the prototype using a variety of media

(11) The student creates justifiable solutions to open-ended real-world problems using engineering design practices and processes. The student is expected to:

(A) identify and define an engineering problem;

(i) identify an engineering problem

(ii) define an engineering problem

(B) formulate goals, objectives, and requirements to solve an engineering problem;

(i) formulate goals to solve an engineering problem

(ii) formulate objectives to solve an engineering problem

(iii) formulate requirements to solve an engineering problem

(C) determine the design parameters such as materials, personnel, resources, funding, manufacturability, feasibility, and time associated with an engineering problem;

(i) determine the design parameters associated with an engineering problem

(D) establish and evaluate constraints, including health, safety, social, environmental, ethical, political, regulatory, and legal, pertaining to a problem;

(i) establish constraints, including health, pertaining to a problem

(ii) establish constraints, including safety, pertaining to a problem

(iii) establish constraints, including social, pertaining to a problem

(iv) establish constraints, including environmental, pertaining to a problem

(v) establish constraints, including ethical, pertaining to a problem

(vi) establish constraints, including political, pertaining to a problem

(vii) establish constraints, including regulatory, pertaining to a problem

(viii) establish constraints, including legal, pertaining to a problem

(ix) evaluate constraints, including health, pertaining to a problem

(x) evaluate constraints, including safety, pertaining to a problem

(xi) evaluate constraints, including social, pertaining to a problem

(xii) evaluate constraints, including environmental, pertaining to a problem

(xiii) evaluate constraints, including ethical, pertaining to a problem

(xiv) evaluate constraints, including political, pertaining to a problem

(xv) evaluate constraints, including regulatory, pertaining to a problem

(xvi) evaluate constraints, including legal, pertaining to a problem

- (E) identify or create alternative solutions to a problem using a variety of techniques such as brainstorming, reverse engineering, and researching engineered and natural solutions;
  - (i) identify or create alternative solutions to a problem using a variety of techniques
- (F) test and evaluate proposed solutions using tools and methods such as models, prototypes, mock-ups, simulations, critical design review, statistical analysis, or experiments; and
  - (i) test proposed solutions using tools
  - (ii) test proposed solutions using methods
  - (iii) evaluate proposed solutions using tools
  - (iv) evaluate proposed solutions using methods
- (G) apply structured techniques such as a decision tree, design matrix, or cost-benefit analysis to select and justify a preferred solution to a problem.
  - (i) apply structured techniques to select a preferred solution to a problem
  - (ii) apply structured techniques to justify a preferred solution to a problem