Engineering Design and Presentation (IMRA26)

Subject: Career Development and Career and Technical Education
Grade: 11
Expectations: 83
Breakouts: 312

Employability Skills

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. These standards may not be offered as a standalone course. These standards shall be offered together with the essential knowledge and skills for career and technical education (CTE) courses in this chapter.

(c) Introduction.

(1) CTE 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 goal of the employability skills standards is to ensure that students develop essential skills for effective performance in the workplace, regardless of the occupation.

(3) These standards are required to be addressed in their entirety as part of each CTE course based on the level of the course in a CTE program of study.

(A) CTE courses identified as Level 1 or Level 2 courses in a CTE program of study must address the employability skills standards identified in subsection (d)(1) of this section.

(B) CTE courses identified as Level 3 or Level 4 courses in a CTE program of study must address the employability skills standards identified in subsection (d)(2) of this section.

(4) 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.

Engineering Design and Presentation

(a) Implementation.

(1) The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(2) School districts shall implement the employability skills student expectations listed in §127.15(d)(2) of this chapter (relating to Career and Technical Education Employability Skills) as an integral part of this course.

(b) General requirements. This course is recommended for students in Grades 10-12. Prerequisite: Algebra I and at least one credit in a course from the Engineering Career Cluster. Recommended prerequisite: Principles of Applied Engineering. Students shall be awarded one credit for successful completion of this course.

(c) 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 Engineering Career Cluster focuses on planning, designing, testing, building, and maintaining machines, structures, materials, systems, and processes using empirical evidence and science, technology, and math principles. This career cluster includes occupations ranging from mechanical engineer and drafter to electrical engineer and mapping technician.

(3) Students enrolled in Engineering Design and Presentation 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 transfer advanced academic skills to component designs. Additionally, students explore career opportunities in engineering, technology, and drafting and learn 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 organizations that foster leadership and career development in the profession such as student chapters of related professional associations.

(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.

(d) Knowledge and Skills Statements

(0) Employability skills--Levels 3 and 4. In a CTE course identified as a Level 3 or Level 4 course in a CTE program of study, the student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) demonstrate dressing appropriately, speaking politely, and conducting oneself in a manner appropriate for the profession and work site

(i) demonstrate dressing appropriately for the profession

(ii) demonstrate speaking politely for the profession

(iii) demonstrate conducting oneself in a manner appropriate for the profession

(iv) demonstrate dressing appropriately for the work site

(v) demonstrate speaking politely for the work site

(vi) demonstrate conducting oneself in a manner appropriate for the work site

(B) analyze how teams can produce better outcomes through cooperation, contribution, and collaboration from members of the team;

(i) analyze how teams can produce better outcomes through cooperation from members of the team

(ii) analyze how teams can produce better outcomes through contribution from members of the team

(iii) analyze how teams can produce better outcomes through collaboration from members of the team

(C) present written and oral technical communication in a clear, concise, and effective manner for a variety of purposes and audiences, including explaining and justifying decisions;

(i) present written technical communication in a clear manner for a variety of purposes, including explaining decisions

(ii) present written technical communication in a concise manner for a variety of purposes, including explaining decisions

(iii) present written technical communication in a[n] effective manner for a variety of purposes, including explaining decisions

(iv) present written technical communication in a clear manner for a variety of audiences, including explaining decisions

(v) present written technical communication in a concise manner for a variety of audiences, including explaining decisions

(vi) present written technical communication in a[n] effective manner for a variety of audiences, including explaining decisions

(vii) present written technical communication in a clear manner for a variety of purposes, including justifying decisions

(viii) present written technical communication in a concise manner for a variety of purposes, including justifying decisions

(ix) present written technical communication in a[n] effective manner for a variety of purposes, including justifying decisions

(x) present written technical communication in a clear manner for a variety of audiences, including justifying decisions

(xi) present written technical communication in a concise manner for a variety of audiences, including justifying decisions

(xii) present written technical communication in a[n] effective manner for a variety of audiences, including justifying decisions

(xiii) present written oral communication in a clear manner for a variety of purposes, including explaining decisions

(xiv) present written oral communication in a concise manner for a variety of purposes, including explaining decisions

(xv) present written oral communication in a[n] effective manner for a variety of purposes, including explaining decisions

(xvi) present written oral communication in a clear manner for a variety of audiences, including explaining decisions

(xvii) present written oral communication in a concise manner for a variety of audiences, including explaining decisions

(xviii) present written oral communication in a[n] effective manner for a variety of audiences, including explaining decisions

(xix) present written oral communication in a clear manner for a variety of purposes, including justifying decisions

(xx) present written oral communication in a concise manner for a variety of purposes, including justifying decisions

(xxi) present written oral communication in a[n] effective manner for a variety of purposes, including justifying decisions

(xxii) present written oral communication in a clear manner for a variety of audiences, including justifying decisions

(xxiii) present written oral communication in a concise manner for a variety of audiences, including justifying decisions

(xxiv) present written oral communication in a[n] effective manner for a variety of audiences, including justifying decisions

(D) use time-management skills independently and in groups to prioritize tasks, follow schedules, and tend to goal-relevant activities in a way that optimizes efficiency and results;

(i) use time-management skills independently to prioritize tasks in a way that optimizes efficiency

(ii) use time-management skills independently to prioritize tasks in a way that optimizes results

(iii) use time-management skills independently to follow schedules in a way that optimizes efficiency

(iv) use time-management skills independently to follow schedules in a way that optimizes results

(v) use time-management skills independently tend to goal-relevant activities in a way that optimizes efficiency

(vi) use time-management skills independently tend to goal-relevant activities in a way that optimizes results

(vii) use time-management skills in groups to prioritize tasks in a way that optimizes efficiency

(viii) use time-management skills in groups to prioritize tasks in a way that optimizes results

(ix) use time-management skills in groups to follow schedules in a way that optimizes efficiency

(x) use time-management skills in groups to follow schedules in a way that optimizes results

(xi) use time-management skills in groups tend to goal-relevant activities in a way that optimizes efficiency

(xii) use time-management skills in groups tend to goal-relevant activities in a way that optimizes results

(E) describe the importance of and demonstrate punctuality, dependability, reliability, and responsibility in reporting for duty and performing assigned tasks as directed;

(i) describe the importance of punctuality in reporting for duty

(ii) describe the importance of dependability in reporting for duty

(iii) describe the importance of reliability in reporting for duty

(iv) describe the importance of responsibility in reporting for duty

(v) describe the importance of punctuality in performing assigned tasks as directed

(vi) describe the importance of dependability in performing assigned tasks as directed

(vii) describe the importance of reliability in performing assigned tasks as directed

(viii) describe the importance of responsibility in performing assigned tasks as directed

(F) demonstrate respect for differences in the workplace;

(i) demonstrate respect for differences in the workplace

(G) identify the importance and benefits of meritocracy, a hard work ethic, and equal opportunity in the workplace;

(i) identify the importance of meritocracy in the workplace

(ii) identify the importance of a hard work ethic in the workplace

(iii) identify the importance of equal opportunity in the workplace

(iv) identify the benefits of meritocracy in the workplace

(v) identify the benefits of a hard work ethic in the workplace

(vi) identify the benefits of equal opportunity in the workplace

(H) identify consequences relating to discrimination and harassment;

(i) identify consequences relating to discrimination

(ii) identify consequences relating to harassment

(I) demonstrate knowledge of personal and occupational health and safety, applicable regulations, and first aid in the workplace and discuss why it is critical for employees and employers to maintain a safe work environment;

(i) demonstrate knowledge of personal health in the workplace

(ii) demonstrate knowledge of personal safety in the workplace

(iii) demonstrate knowledge of occupational health in the workplace

(iv) demonstrate knowledge of occupational safety in the workplace

(v) demonstrate knowledge of applicable regulations in the workplace

(vi) demonstrate knowledge of first aid in the workplace

(vii) discuss why it is critical for employees to maintain a safe work environment

(viii) discuss why it is critical for employers to maintain a safe work environment

(J) compare skills and characteristics of managers and leaders in the workplace; and

(i) compare skills and characteristics of managers in the workplace

(ii) compare skills and characteristics of leaders in the workplace

(K) identify career development opportunities in the field:(i) education and training;(ii) credentialing;(iii) internships and apprenticeships; and(iv) entrepreneurship opportunities;

(i) identify career development opportunities in the field: education

(ii) identify career development opportunities in the field: training

(iii) identify career development opportunities in the field: credentialing

(iv) identify career development opportunities in the field: internships

(v) identify career development opportunities in the field: apprenticeships

(vi) identify career development opportunities in the field: entrepreneurship opportunities

(L) demonstrate an understanding of legal and ethical responsibilities in relation to the field.

(i) demonstrate an understanding of legal responsibilities in relation to the field

(ii) demonstrate an understanding of ethical responsibilities in relation to the field

(1) The student researches and describes ethics pertaining to engineering. The student is expected to explain how engineering ethics as defined by the Texas Board of Professional Engineers and Land Surveyors apply to engineering practice.

(A) explain how engineering ethics as defined by the Texas Board of Professional Engineers and Land Surveyors apply to engineering practice.

(i) explain how engineering ethics as defined by the Texas Board of Professional Engineers and Land Surveyors apply to engineering practice

(2) The student understands how to implement an engineering design process to develop a product or solution. The student is expected to:

(A) describe and implement the stages of an engineering design process to construct a model;

(i) describe the stages of an engineering design process to construct a model

(ii) implement the stages of an engineering design process to construct a model

(B) explain how factors, including complexity, scope, resources, ethics, regulations, manufacturability, maintainability, and technology, impact stages of the engineering design process;

(i) explain how factors, including complexity, impact stages of the engineering design process

(ii) explain how factors, including scope, impact stages of the engineering design process

(iii) explain how factors, including resources, impact stages of the engineering design process

(iv) explain how factors, including ethics, impact stages of the engineering design process

(v) explain how factors, including regulations, impact stages of the engineering design process

(vi) explain how factors, including manufacturability, impact stages of the engineering design process

(vii) explain how factors, including maintainability, impact stages of the engineering design process

(viii) explain how factors, including technology, impact stages of the engineering design process

(C) explain how stakeholders impact an engineering design process; and

(i) explain how stakeholders impact an engineering design process

(D) analyze how failure is often an essential component of the engineering design process.

(i) analyze how failure is often an essential component of the engineering design process

(3) The student understands the value of maintaining documentation using an engineering notebook. The student is expected to:

(A) explain the legal value of maintaining an engineering notebook as intellectual property;

(i) explain the legal value of maintaining an engineering notebook as intellectual property

(B) describe the proper implementation of an engineering notebook, including notebook type, documentation, signatures, adding external materials, sealing, and dating; and

(i) describe the proper implementation of an engineering notebook, including notebook type

(ii) describe the proper implementation of an engineering notebook, including documentation

(iii) describe the proper implementation of an engineering notebook, including signatures

(iv) describe the proper implementation of an engineering notebook, including adding external materials

(v) describe the proper implementation of an engineering notebook, including sealing

(vi) describe the proper implementation of an engineering notebook, including dating

(C) create and maintain an engineering notebook by recording ideas, notes, decisions, findings, and corrections.

(i) create an engineering notebook by recording ideas

(ii) create an engineering notebook by recording notes

(iii) create an engineering notebook by recording decisions

(iv) create an engineering notebook by recording findings

(v) create an engineering notebook by recording corrections

(vi) maintain an engineering notebook by recording ideas

(vii) maintain an engineering notebook by recording notes

(viii) maintain an engineering notebook by recording decisions

(ix) maintain an engineering notebook by recording findings

(x) create an engineering notebook by recording corrections

(4) The student explores the methods and aspects of project management in relation to projects. The student is expected to:

(A) research and explain the process and phases of project management, including initiating, planning, executing, and closing;

(i) research the process of project management, including initiating

(ii) research the process of project management, including planning

(iii) research the process of project management, including executing

(iv) research the process of project management, including closing

(v) research the phases of project management, including initiating

(vi) research the phases of project management, including planning

(vii) research the phases of project management, including executing

(viii) research the phases of project management, including closing

(ix) explain the process of project management, including initiating

(x) explain the process of project management, including planning

(xi) explain the process of project management, including executing

(xii) explain the process of project management, including closing

(xiii) explain the phases of project management, including initiating

(xiv) explain the phases of project management, including planning

(xv) explain the phases of project management, including executing

(xvi) explain the phases of project management, including closing

(B) explain the roles and responsibilities of team members, including project managers and leads;

(i) explain the roles of team members, including project managers

(ii) explain the roles of team members, including project leads

(iii) explain the responsibilities of team members, including project managers

(iv) explain the responsibilities of team members, including project leads

(C) research and evaluate methods and tools available for managing a project;

(i) research methods available for managing a project

(ii) research tools available for managing a project

(iii) evaluate methods available for managing a project

(iv) evaluate tools available for managing a project

(D) discuss the importance of developing and implementing a system for the organization of project documentation such as file naming conventions, document release control, and version control;

(i) discuss the importance of developing a system for the organization of project documentation

(ii) discuss the importance of implementing a system for the organization of project documentation

(E) describe how project requirements, constraints, and deliverables impact the project schedule and influence an engineering design;

(i) describe how project requirements impact the project schedule

(ii) describe how project requirements influence an engineering design

(iii) describe how project constraints impact the project schedule

(iv) describe how project constraints influence an engineering design

(v) describe how project deliverables impact the project schedule

(vi) describe how project deliverables influence an engineering design

(F) explain how a project budget, including materials, equipment, and labor, is developed and maintained; and

(i) explain how a project budget, including materials, is developed

(ii) explain how a project budget, including equipment, is developed

(iii) explain how a project budget, including labor, is developed

(iv) explain how a project budget, including materials, is maintained

(v) explain how a project budget, including equipment, is maintained

(vi) explain how a project budget, including labor, is maintained

(G) describe the importance of management of change (MOC) and how MOC applies to project planning.

(i) describe the importance of management of change (MOC)

(ii) describe how MOC applies to project planning

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

(A) describe and compare the roles of an industry technician, engineering technologist, and engineer;

(i) describe the role of an industry technician

(ii) describe the role of an industry engineering technologist

(iii) describe the roles of an industry engineer

(iv) compare the roles of an industry technician, engineering technologist, and engineer

(B) identify educational requirements and career opportunities for engineers, engineering technologists, and industry technicians;

(i) identify educational requirements for engineers

(ii) identify educational requirements for engineering technologists

(iii) identify educational requirements for industry technicians

(iv) identify career opportunities for engineers

(v) identify career opportunities for engineering technologists

(vi) identify career opportunities for industry technicians

(C) research and describe various engineering disciplines such as mechanical, civil, aerospace, biomedical, chemical civil, computer, electrical, petroleum, and other related and emerging fields;

(i) research various engineering disciplines

(ii) describe various engineering disciplines

(D) investigate and describe the requirements of engineering licensure and industry-based certifications;

(i) investigate the requirements of engineering licensure

(ii) investigate the requirements of industry-based certifications

(iii) describe the requirements of engineering licensure

(iv) describe the requirements of industry-based certifications

(E) investigate and describe elements of teamwork critical for success in the engineering and technology industries such as communication, active listening, and time management;

(i) investigate elements of teamwork critical for success in the engineering [industry]

(ii) investigate elements of teamwork critical for success in the technology [industry]

(iii) describe elements of teamwork critical for success in the engineering [industry]

(iv) describe elements of teamwork critical for success in the technology [industry]

(F) research and describe industry standards and governmental regulations such as health and safety and environmental regulations applicable to a design problem; and

(i) research industry standards applicable to a design problem

(ii) research governmental regulations applicable to a design problem

(iii) describe industry standards applicable to a design problem

(iv) describe governmental regulations applicable to a design problem

(G) analyze and discuss ethical issues related to engineering and technology.

(i) analyze ethical issues related to engineering

(ii) analyze ethical issues related to technology

(iii) discuss ethical issues related to engineering

(iv) discuss ethical issues related to technology

(6) The student understands the roles and responsibilities of individual team members, how successful teams function, and how to constructively contribute to the team. The student is expected to:

(A) describe the various roles and responsibilities of a project team;

(i) describe the various roles of a project team

(ii) describe the various responsibilities of a project team

(B) identify the strengths of individual team members to assign roles and distribute tasks within a team; and

(i) identify the strengths of individual team members to assign roles within a team

(ii) identify the strengths of individual team members to distribute tasks within a team

(C) describe and demonstrate appropriate behaviors such as active listening and clear communication while serving as a team leader and member on projects.

(i) describe appropriate behaviors while serving as a team leader on projects

(ii) describe appropriate behaviors while serving as a team member on projects

(iii) demonstrate appropriate behaviors while serving as a team leader on projects

(iv) demonstrate appropriate behaviors while serving as a team member on projects

(7) The student practices safe and proper work habits. The student is expected to:

(A) identify and explain the appropriate use of types of personal protective equipment used in industry;

(i) identify the appropriate use of types of personal protective equipment used in industry

(ii) explain the appropriate use of types of personal protective equipment used in industry

(B) explain and comply with safety guidelines and procedures as described in relevant manuals, instructions, and regulations;

(i) explain safety guidelines as described in relevant manuals

(ii) explain safety guidelines as described in relevant instructions

(iii) explain safety guidelines as described in relevant regulations

(iv) explain safety procedures as described in relevant manuals

(v) explain safety procedures as described in relevant instructions

(vi) explain safety procedures as described in relevant regulations

(vii) comply with safety guidelines as described in relevant manuals

(viii) comply with safety guidelines as described in relevant instructions

(ix) comply with safety guidelines as described in relevant regulations

(x) comply with safety procedures as described in relevant manuals

(xi) comply with safety procedures as described in relevant instructions

(xii) comply with safety procedures as described in relevant regulations

(C) discuss the importance of safe walking and working surfaces in the workplace and best practices for preventing or reducing slips, trips, and falls in the workplace;

(i) discuss the importance of safe walking surfaces in the workplace

(ii) discuss the importance of safe working surfaces in the workplace

(iii) discuss the best practices for preventing or reducing slips in the workplace

(iv) discuss the best practices for preventing or reducing trips in the workplace

(v) discuss the best practices for preventing or reducing falls in the workplace

(D) describe the various types of electrical hazards in the workplace and the risks associated with electrical hazards;

(i) describe the various types of electrical hazards in the workplace

(ii) describe the risks associated with electrical hazards

(E) describe the various control methods to prevent electrical hazards in the workplace;

(i) describe the various control methods to prevent electrical hazards in the workplace

(F) identify workplace health and safety resources, including emergency plans and Safety Data Sheets, and explain how emergency plans and Safety Data Sheets are used to make decisions in the workplace;

(i) identify workplace health resources, including emergency plans

(ii) identify workplace safety resources, including emergency plans

(iii) identify workplace health resources, including Safety Data Sheets

(iv) identify workplace safety resources, including Safety Data Sheets

(v) explain how emergency plans are used to make decisions in the workplace

(vi) explain how Safety Data Sheets are used to make decisions in the workplace

(G) describe the appropriate disposal of selected hazardous materials and wastes;

(i) describe the appropriate disposal of selected hazardous materials

(ii) describe the appropriate disposal of selected hazardous wastes

(H) perform routine maintenance on selected tools, equipment, and machines;

(i) perform routine maintenance on selected tools

(ii) perform routine maintenance on selected equipment

(iii) perform routine maintenance on selected machines

(I) demonstrate proper handling, use, and storage of tools and materials; and

(i) demonstrate proper handling of tools

(ii) demonstrate proper handling of materials

(iii) demonstrate proper use of tools

(iv) demonstrate proper use of materials

(v) demonstrate proper storage of tools

(vi) demonstrate proper storage of materials

(J) research and describe the consequences of negligent or improper equipment maintenance.

(i) research the consequences of negligent or improper equipment maintenance.

(ii) describe the consequences of negligent or improper equipment maintenance.

(8) The student understands how visual and spatial reasoning applies to engineering design. The student is expected to:

(A) describe and compare characteristics and dimensional changes of two-dimensional (2D) and three-dimensional (3D) figures;

(i) describe characteristics of two-dimensional (2D) figures

(ii) describe characteristics three-dimensional (3D) figures

(iii) describe dimensional changes of two-dimensional (2D)figures

(iv) describe dimensional changes of three-dimensional (3D) figures

(v) compare characteristics of two-dimensional (2D) and three-dimensional (3D) figures

(vi) compare dimensional changes of two-dimensional (2D) and three-dimensional (3D) figures

(B) draw and manipulate geometric shapes in three dimensions;

(i) draw geometric shapes in three dimensions

(ii) manipulate geometric shapes in three dimensions

(C) create 2D views of a 3D object; and

(i) create 2D views of a 3D object

(D) explain the symmetry of figures through the proportionate transformation of objects.

(i) explain the symmetry of figures through the proportionate transformation of objects.

(9) The student uses sketching and computer-aided design and drafting (CADD) to represent 3D objects in a 2D format needed for manufacturing an object. The student is expected to:

(A) use single and multi-view projections to represent 3D objects in a 2D format;

(i) use single-view projections to represent 3D objects in a 2D format

(ii) use multi-view projections to represent 3D objects in a 2D format

(B) use appropriate line types in engineering drawings to represent 3D objects in a 2D format;

(i) use appropriate line types in engineering drawings to represent 3D objects in a 2D format

(C) use orthographic and pictorial views to represent 3D objects in a 2D format;

(i) use orthographic views to represent 3D objects in a 2D format

(ii) use pictorial views to represent 3D objects in a 2D format

(D) use auxiliary views to represent 3D objects in a 2D format;

(i) use auxiliary views to represent 3D objects in a 2D format

(E) use section views to represent 3D objects in a 2D format;

(i) use section views to represent 3D objects in a 2D format

(F) prepare and revise annotated multi-dimensional production drawings in computer-aided design and drafting to industry standards;

(i) prepare annotated multi-dimensional production drawings in computer-aided design and drafting [CADD] to industry standards

(ii) revise annotated multi-dimensional production drawings in computer-aided design and drafting [CADD] to industry standards

(G) apply best practices for file structure and management to efficiently retrieve and edit files;

(i) apply best practices for file structure to efficiently retrieve files

(ii) apply best practices for file structure to efficiently edit files

(iii) apply best practices for file management to efficiently retrieve files

(iv) apply best practices for file management to efficiently edit files

(H) use advanced dimensioning techniques, including annotation scale; and

(i) use advanced dimensioning techniques, including annotation scale

(I) construct and use CADD drawings to develop a model or prototype for presentation.

(i) construct CADD drawings to develop a model or prototype for presentation.

(ii) use CADD drawings to develop a model or prototype for presentation.

(10) The student designs products using appropriate engineering design processes and techniques. The student is expected to:

(A) design product components using a variety of technologies;

(i) design product components using a variety of technologies

(B) research and analyze the applications of different types of CADD software for various engineering problems;

(i) research the applications of different types of CADD software for various engineering problems

(ii) analyze the applications of different types of CADD software for various engineering problems

(C) create and interpret engineering drawings using industry standards;

(i) create engineering drawings using industry standards

(ii) interpret engineering drawings using industry standards

(D) describe how quality, reliability, and safety can be designed into specific products;

(i) describe how quality can be designed into specific products

(ii) describe how reliability can be designed into specific products

(iii) describe how safety can be designed into specific products

(E) identify specific requirements of users with special needs and modify a product design to accommodate users with special needs;

(i) identify specific requirements of users with special needs

(ii) modify a product design to accommodate users with special needs

(F) research and explain the patenting process and analyze opportunities for potential patents related to a project; and

(i) research the patenting process

(ii) explain the patenting process

(iii) analyze opportunities for potential patents related to a project

(G) use multiple software applications for concept presentations.

(i) use multiple software applications for concept presentations.

(11) The student builds a prototype(s) 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;

(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 and explain how the prototype meets the project requirements; and

(i) present the prototype

(ii) explain how the prototype meets the project requirements

(D) evaluate the successes and failures of the prototype(s) in the context of an iterative design process.

(i) evaluate the successes of the prototype(s) in the context of an iterative design process

(ii) evaluate the failures of the prototype(s) in the context of an iterative design process

(12) 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) investigate and select appropriate materials for a particular product to be designed;

(i) investigate appropriate materials for a particular product to be designed

(ii) select appropriate materials for a particular product to be designed

(D) explain the importance of manufacturability and maintainability when designing a product;

(i) explain the importance of manufacturability when designing a product

(ii) explain the importance of maintainability when designing a product

(E) determine design constraints such as personnel, resources, funding, feasibility, and time associated with an engineering problem;

(i) determine design constraints associated with an engineering problem

(F) identify requirements, including health, safety, social, environmental, ethical, regulatory, and legal constraints, defining an engineering problem;

(i) identify requirements, including health constraints, defining an engineering problem

(ii) identify requirements, including safety constraints, defining an engineering problem

(iii) identify requirements, including social constraints, defining an engineering problem

(iv) identify requirements, including environmental constraints, defining an engineering problem

(v) identify requirements, including ethical constraints, defining an engineering problem

(vi) identify requirements, including regulatory constraints, defining an engineering problem

(vii) identify requirements, including legal constraints, defining an engineering problem

(G) identify alternative solutions to a problem using a variety of techniques such as brainstorming, reverse engineering, and researching engineered and natural solutions;

(i) identify alternative solutions to a problem using a variety of techniques

(H) test and evaluate proposed solutions using engineering practices such as experiments, simulations, statistical analysis, and critical design review; and

(i) test proposed solutions using engineering practices

(ii) evaluate proposed solutions using engineering practices

(I) select and justify a preferred solution to a problem using structured techniques such as a decision tree, design matrix, or cost-benefit analysis.

(i) select a preferred solution to a problem using structured techniques

(ii) justify a preferred solution to a problem using structured techniques

(13) The student presents a solution derived through the engineering design process. The student is expected to:

(A) present the solution in a professional manner;

(i) present the solution in a professional manner

(B) solicit and evaluate feedback on the solution and presentation; and

(i) solicit feedback on the solution

(ii) solicit feedback on the presentation

(iii) evaluate feedback on the solution

(iv) evaluate feedback on the presentation

(C) present learning experiences, including essential skills gained, areas of personal growth, challenges, and solutions, encountered throughout the design process.

(i) present learning experiences, including essential skills gained, encountered throughout the design process.

(ii) present learning experiences, including areas of personal growth, encountered throughout the design process.

(iii) present learning experiences, including challenges, encountered throughout the design process.

(iv) present learning experiences, including solutions, encountered throughout the design process.