

# Advanced Engineering Design and Presentation (IMRA26)

Subject: Career Development and Career and Technical Education

Grade: 12

Expectations: 82

Breakouts: 305

## Career and Technical Education 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.
  - (4) 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.
  - (5) 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.
  - (6) 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.

## Advanced 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 11 and 12. Prerequisites: Algebra I, Geometry, and Engineering Design and Presentation. Students shall be awarded two credits 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) Advanced Engineering Design and Presentation is a continuation of knowledge and skills learned in Engineering Design and Presentation. Students enrolled in this course demonstrate advanced knowledge and skills of a system 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. Students expand on the use of a variety of computer hardware and software applications to complete assignments and projects. Through implementation of a system design process, students transfer advanced academic skills to component designs and engineering systems. Emphasis is placed on transdisciplinary and integrative approaches using skills from ideation, prototyping, and project management methods.
- (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: education and training; credentialing; internships and apprenticeships; and entrepreneurship opportunities; and
  - (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 interested parties impact an engineering design process; and
- (i) explain how interested parties 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 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
  - (ii) research the phases of project management, including initiating
  - (iii) research the phases of project management, including planning
  - (iv) research the phases of project management, including executing
  - (v) research the phases of project management, including closing
  - (vi) explain the process of project management
  - (vii) explain the phases of project management, including initiating
  - (viii) explain the phases of project management, including planning
  - (ix) explain the phases of project management, including executing
  - (x) 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, influence an engineering design, and are influenced by 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 requirements are influenced by an engineering design
  - (iv) describe how project constraints impact the project schedule
  - (v) describe how project constraints influence an engineering design
  - (vi) describe how project constraints are influenced by an engineering design

- (vii) describe how project deliverables impact the project schedule
  - (viii) describe how project deliverables influence an engineering design
  - (ix) describe how project deliverables are influenced by 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
- (4) 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 procedures as described in relevant manuals
  - (iii) explain safety guidelines as described in relevant instructions
  - (iv) explain safety procedures as described in relevant instructions
  - (v) explain safety guidelines as described in relevant regulations
  - (vi) explain safety procedures as described in relevant regulations
  - (vii) comply with safety guidelines as described in relevant manuals
  - (viii) comply with safety procedures as described in relevant manuals
  - (ix) comply with safety guidelines as described in relevant instructions
  - (x) comply with safety procedures as described in relevant instructions
  - (xi) comply with safety guidelines as described in relevant regulations
  - (xii) comply with safety procedures as described in relevant regulations
- (C) explain the importance of lock out tag out (LOTO) procedures in preventing the release of hazardous energy;

- (i) explain the importance of lock out tag out (LOTO) procedures in preventing the release of hazardous energy
- (D) explain 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) explain the importance of safe walking surfaces in the workplace
  - (ii) explain the importance of safe working surfaces in the workplace
  - (iii) explain best practices for preventing or reducing slips in the workplace
  - (iv) explain best practices for preventing or reducing trips in the workplace
  - (v) explain best practices for preventing or reducing falls in the workplace
- (E) 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
- (F) 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
- (G) identify workplace health and safety resources, including emergency plans and Safety Data Sheets, and explain how health and safety resources 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 health resources are used to make decisions in the workplace
  - (vi) explain how safety resources are used to make decisions in the workplace
- (H) 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
- (I) 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
- (J) handle, use, and store tools and materials correctly; and
- (i) handle tools correctly
  - (ii) use tools correctly
  - (iii) store tools correctly

- (iv) handle materials correctly
  - (v) use materials correctly
  - (vi) store materials correctly
- (K) 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
- (5) The student demonstrates 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) demonstrate the various roles and responsibilities of a project team;
    - (i) demonstrate the various roles of a project team
    - (ii) demonstrate the various responsibilities of a project team
  - (B) create a plan to improve team member's skillsets based on strengths of individual team members;
    - (i) create a plan to improve team member's skillsets based on strengths of individual team members
  - (C) demonstrate appropriate behaviors of a successful team such as active listening, development of consensus, and clear communication while serving as a team leader and member on projects; and
    - (i) demonstrate appropriate behaviors of a successful team while serving as a team leader on projects
    - (ii) demonstrate appropriate behaviors of a successful team while serving as a team member on projects
  - (D) describe and demonstrate the roles and responsibilities specific to team leaders such as assigning roles and responsibilities, facilitating decision making, tracking progress, and soliciting and providing timely feedback to team members.
    - (i) describe the roles specific to team leaders
    - (ii) describe the responsibilities specific to team leaders
    - (iii) demonstrate the roles specific to team leaders
    - (iv) demonstrate the responsibilities specific to team leaders
- (6) The student uses and documents engineering design processes. The student is expected to:
- (A) use idea generation techniques such as brainstorming, sketching, rapid prototyping, and mind mapping during conceptual stages and for resolving problems of an engineering project;
    - (i) use idea generation techniques during conceptual stages
    - (ii) use idea generation techniques for resolving problems of an engineering project
  - (B) analyze and evaluate solution constraints;
    - (i) analyze solution constraints
    - (ii) evaluate solution constraints
  - (C) develop or improve a solution using evidence-based decision-making;

- (i) develop or improve a solution using evidence-based decision-making
- (D) compare solutions using analysis tools such as a decision matrix or paired comparison analysis;
  - (i) compare solutions using analysis tools
- (E) create and maintain an organized engineering notebook to record findings and corrections, including deficiencies in the design process and decisions throughout the entire design process; and
  - (i) create an organized engineering notebook to record findings, including deficiencies in the design process
  - (ii) create an organized engineering notebook to record corrections, including deficiencies in the design process
  - (iii) create an organized engineering notebook to record findings, including decisions throughout the entire design process
  - (iv) create an organized engineering notebook to record corrections, including decisions throughout the entire design process
  - (v) maintain an organized engineering notebook to record findings, including deficiencies in the design process
  - (vi) maintain an organized engineering notebook to record corrections, including deficiencies in the design process
  - (vii) maintain an organized engineering notebook to record findings, including decisions throughout the entire design process
  - (viii) maintain an organized engineering notebook to record corrections, including decisions throughout the entire design process
- (F) develop an engineering notebook or portfolio to record and justify the final design, construction, and manipulation of finished projects.
  - (i) develop an engineering notebook or portfolio to record the final design of finished projects
  - (ii) develop an engineering notebook or portfolio to record the construction of finished projects
  - (iii) develop an engineering notebook or portfolio to record the manipulation of finished projects
  - (iv) develop an engineering notebook or portfolio to justify the final design of finished projects
  - (v) develop an engineering notebook or portfolio to justify the construction of finished projects
  - (vi) develop an engineering notebook or portfolio to justify the manipulation of finished projects
- (7) The student understands how systems impact the design, integration, and management of engineering solutions. The student is expected to:
  - (A) analyze and document systems such as electrical, mechanical, or information processes within a product or design concept in engineering;
    - (i) analyze systems within a product or design concept in engineering
    - (ii) document systems within a product or design concept in engineering
  - (B) explain ethical reverse engineering;

- (i) explain ethical reverse engineering
  - (C) reverse engineer a multi-system product and explain how the systems work together; and
    - (i) reverse engineer a multi-system product
    - (ii) explain how the systems work together [in a multi-system product]
  - (D) modify a system design to meet a newly identified need or to improve performance.
    - (i) modify a system design to meet a newly identified need or to improve performance
- (8) The student demonstrates proficiency using computer-aided design and drafting (CADD) software as part of the engineering design process. The student is expected to:
- (A) research and explain the features and benefits of different types of CADD software applications for use in design systems and problem solving;
    - (i) research the features of different types of CADD software applications for use in design systems
    - (ii) research the features of different types of CADD software applications for use in problem solving
    - (iii) research the benefits of different types of CADD software applications for use in design systems
    - (iv) research the benefits of different types of CADD software applications for use in problem solving
    - (v) explain the features of different types of CADD software applications for use in design systems
    - (vi) explain the features of different types of CADD software applications for use in problem solving
    - (vii) explain the benefits of different types of CADD software applications for use in design systems
    - (viii) explain the benefits of different types of CADD software applications for use in problem solving
  - (B) identify and describe industry graphic standards such as American National Standards Institute (ANSI) and International Organization for Standardization (ISO) standards;
    - (i) identify industry graphic standards
    - (ii) describe industry graphic standards
  - (C) create drawings that meet industry standards using CADD software;
    - (i) create drawings that meet industry standards using CADD software
  - (D) customize CADD software user interface options such as buttons, tabs, and ribbons to match different digital work environments;
    - (i) customize CADD software user interface options to match different digital work environments
  - (E) prepare and use advanced views such as auxiliary, section, and break-away using CADD software;
    - (i) prepare advanced views using CADD software
    - (ii) use advanced views using CADD software
  - (F) draw detailed parts, assembly diagrams, and sub-assembly diagrams using CADD software;
    - (i) draw detailed parts using CADD software
    - (ii) draw assembly diagrams using CADD software

- (iii) draw sub-assembly diagrams using CADD software
- (G) indicate tolerances and standard fittings using appropriate library functions within CADD software;
  - (i) indicate tolerances using appropriate library functions within CADD software
  - (ii) indicate standard fittings using appropriate library functions within CADD software
- (H) setup and apply annotation styles by defining fonts, dimension styles, and leader lines using CADD software;
  - (i) setup annotation styles by defining fonts using CADD software
  - (ii) setup annotation styles by defining dimension styles using CADD software
  - (iii) setup annotation styles by defining leader lines using CADD software
  - (iv) apply annotation styles by defining fonts using CADD software
  - (v) apply annotation styles by defining dimension styles using CADD software
  - (vi) apply annotation styles by defining leader lines using CADD software
- (I) identify and incorporate the use of advanced layout techniques and viewports using paper-space and modeling areas using CADD software;
  - (i) identify advanced layout techniques using paper-space using CADD software
  - (ii) identify advanced layout techniques using modeling areas using CADD software
  - (iii) identify advanced layout techniques using modeling areas using CADD software
  - (iv) identify advanced layout viewports using paper-space using CADD software
  - (v) identify advanced layout viewports using modeling areas using CADD software
  - (vi) incorporate the use of advanced layout techniques using paper-space using CADD software
  - (vii) incorporate the use of advanced layout techniques using modeling areas using CADD software
  - (viii) incorporate the use of advanced layout techniques using modeling areas using CADD software
  - (ix) incorporate the use of advanced layout viewports using paper-space using CADD software
  - (x) incorporate the use of advanced layout viewports using modeling areas using CADD software
- (J) create and use layers to organize objects in drawings using CADD software;
  - (i) create layers to organize objects in drawings using CADD software
  - (ii) use layers to organize objects in drawings using CADD software
- (K) create and use custom templates using CADD software for advanced project management;
  - (i) create custom templates using CADD software for advanced project management
  - (ii) use custom templates using CADD software for advanced project management
- (L) use advanced polar tracking and blocking techniques using CADD software to increase drawing efficiency;
  - (i) use advanced polar tracking using CADD software to increase drawing efficiency
  - (ii) use advanced blocking techniques using CADD software to increase drawing efficiency

- (M) create drawings that incorporate external referencing using CADD software;
    - (i) create drawings that incorporate external referencing using CADD software
  - (N) create and render objects using parametric modeling tools within CADD software; and
    - (i) create objects using parametric modeling tools within CADD software
    - (ii) render objects using parametric modeling tools within CADD software
  - (O) model individual parts or assemblies and produce rendered or animated output using CADD software.
    - (i) model individual parts or assemblies using CADD software
    - (ii) produce rendered or animated output using CADD software
- (9) The student builds a prototype using the appropriate tools, materials, and techniques. The student is expected to:
- (A) delineate and implement the steps such as defining the problem and generating concepts needed to produce a prototype;
    - (i) delineate the steps needed to produce a prototype
    - (ii) implement the steps needed to produce a prototype
  - (B) develop a prototype safely using tools, equipment, machines, or precision measuring instruments;
    - (i) develop a prototype safely using tools, equipment, machines, or precision measuring instruments
  - (C) select and justify the use of materials for prototyping and manufacturing;
    - (i) select the use of materials for prototyping
    - (ii) select the use of materials for manufacturing
    - (iii) justify the use of materials for prototyping
    - (iv) justify the use of materials for manufacturing
  - (D) describe how design quality concepts, including performance, usability, accessibility, reliability, and safe use, affect prototype development;
    - (i) describe how design quality concepts, including performance, affect prototype development
    - (ii) describe how design quality concepts, including usability, affect prototype development
    - (iii) describe how design quality concepts, including accessibility, affect prototype development
    - (iv) describe how design quality concepts, including reliability, affect prototype development
    - (v) describe how design quality concepts, including safe use, affect prototype development
  - (E) document quality-control requirements in the design and production of a prototype;
    - (i) document quality-control requirements in the design of a prototype
    - (ii) document quality-control requirements in the production of a prototype
  - (F) evaluate prototype quality and performance to meet design criteria;
    - (i) evaluate prototype quality to meet design criteria

- (ii) evaluate prototype performance to meet design criteria
  - (G) fabricate a prototype using a systems engineering approach to compare the actual prototype performance to the required performance; and
    - (i) fabricate a prototype using a systems engineering approach to compare the actual prototype performance to the required performance
  - (H) present a prototype and explain how the prototype meets the project requirements.
    - (i) present a prototype
    - (ii) explain how the prototype meets the project requirements
- (10) The student creates justifiable solutions to open-ended real-world problems within a multitude of engineering disciplines using engineering design practices and processes. The student is expected to:
- (A) identify and define a multi-system engineering problem requiring a complex solution from different engineering disciplines such as aerospace, biomedical, chemical, civil, electrical, industrial, mechanical, petroleum, robotics, or structural engineering;
    - (i) identify a multi-system engineering problem requiring a complex solution from different engineering disciplines
    - (ii) define a multi-system engineering problem requiring a complex solution from different engineering disciplines
  - (B) formulate and document goals, objectives, and requirements to solve a multi-system engineering problem;
    - (i) formulate goals to solve a multi-system engineering problem
    - (ii) formulate objectives to solve a multi-system engineering problem
    - (iii) formulate requirements to solve a multi-system engineering problem
    - (iv) document goals to solve a multi-system engineering problem
    - (v) document objectives to solve a multi-system engineering problem
    - (vi) document requirements to solve a multi-system engineering problem
  - (C) determine the design constraints such as materials, personnel, resources, funding, manufacturability, feasibility, and time associated with a multi-system engineering problem;
    - (i) determine the design constraints associated with a multi-system engineering problem
  - (D) identify parameters, including health, safety, social, environmental, ethical, regulatory, and legal constraints, defining a multi-system engineering problem;
    - (i) identify parameters, including health constraints, defining a multi-system engineering problem
    - (ii) identify parameters, including safety constraints, defining a multi-system engineering problem
    - (iii) identify parameters, including social constraints, defining a multi-system engineering problem
    - (iv) identify parameters, including environmental constraints, defining a multi-system engineering problem
    - (v) identify parameters, including ethical constraints, defining a multi-system engineering problem
    - (vi) identify parameters, including regulatory constraints, defining a multi-system engineering problem

- (vii) identify parameters, including legal constraints, defining a multi-system engineering problem
  - (E) identify or create alternative solutions to a multi-system engineering 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 multi-system engineering problem using a variety of techniques
  - (F) test and evaluate proposed multi-system engineering solutions using tools such as models, prototypes, and mockups and methods such as simulations, critical design review, statistical analysis, and experiments; and
    - (i) test proposed multi-system engineering solutions using tools
    - (ii) test proposed multi-system engineering solutions using methods
    - (iii) evaluate proposed multi-system engineering solutions using tools
    - (iv) evaluate proposed multi-system engineering solutions using methods
  - (G) select and justify a preferred solution to a multi-system engineering problem using a structured technique such as a decision tree, design matrix, or cost-benefit analysis.
    - (i) select a preferred solution to a multi-system engineering problem using a structured technique
    - (ii) justify a preferred solution to a multi-system engineering problem using a structured technique
- (11) The student presents a solution derived through the engineering design process. The student is expected to:
- (A) develop and deliver a presentation describing the solution to a multi-system engineering problem in a professional manner to an appropriate audience such as peers, educators, potential clients, potential employers, community members, or engineering professionals;
    - (i) develop a presentation describing the solution to a multi-system engineering problem in a professional manner to an appropriate audience
    - (ii) deliver a presentation describing the solution to a multi-system engineering problem in a professional manner to an appropriate audience
  - (B) solicit and evaluate feedback from the audience on the multi-system engineering solution and presentation; and
    - (i) solicit feedback from the audience on the multi-system engineering solution
    - (ii) solicit feedback from the audience on the multi-system engineering presentation
    - (iii) evaluate feedback from the audience on the multi-system engineering solution
    - (iv) evaluate feedback from the audience on the multi-system engineering presentation
  - (C) present learning experiences, including essential skills gained, areas of personal growth, challenges, and solutions encountered throughout the design process for a multi-system engineering solution.
    - (i) present learning experiences, including essential skills gained, encountered throughout the design process for a multi-system engineering solution.
    - (ii) present learning experiences, including areas of personal growth, encountered throughout the design process for a multi-system engineering solution.
    - (iii) present learning experiences, including challenges, encountered throughout the design process for a multi-system engineering solution.

- (iv) present learning experiences, including solutions, encountered throughout the design process for a multi-system engineering solution.