

PROGRAM CONCENTRATION: Engineering & Technology
CAREER PATHWAY: Engineering
COURSE TITLE: Engineering Concepts

Engineering Concepts is second course in the engineering pathway. This course introduces students to the fundamental principles of engineering. Students learn about areas of specialization within engineering and engineering design, and apply engineering tools and procedures as they complete hands-on instructional activities.

ENGR-EC1 – Students will describe the history and characteristics of engineering disciplines.

- (a) Explain a contemporary definition of engineering.
- (b) Describe the history and development of engineering.
- (c) Compare and contrast engineering to other approaches for solving technological and design problems.
- (d) Explain what engineers do.
- (e) Describe the principal fields of engineering specialization and identify associated career tracks.
- (f) Identify educational requirements for engineering occupations along with locations where programs of study are available.

Academic Standards:

SCSh8. Students will understand important features of the process of scientific inquiry.

MM3P4. Students will make connections among mathematical ideas and to other disciplines.

ENGR-EC2 – Students will demonstrate the engineering design process.

- (a) Describe the role of problem identification, problem definition, search, constraints, criteria, alternative solutions, analysis, decision, specification, and communication as activities comprising the engineering design process.
- (b) Organize the iterative processes necessary to develop and optimize a design solution.
- (c) Apply engineering design to the solution of a problem.

Academic Standards:

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

SCSh3. Students will identify and investigate problems scientifically.

MM3P1. Students will solve problems (using appropriate technology).

MM3P2. Students will reason and evaluate mathematical arguments.

ENGR-EC3 – Students will solve problems using basic engineering tools and resources.

- (a) Explain various measuring systems and their base units.

- (b) Demonstrate applications of precision measuring instruments to describe parts and inspect artifacts.
- (c) Perform keyboard functions using a scientific, hand-held calculator.
- (d) Create an Excel spreadsheet to perform basic arithmetic and algebraic computations on data related to an engineering design problem.
- (e) Use laboratory tools and equipment to determine the properties of materials.

Academic Standards:

SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

MM3P1. Students will solve problems (using appropriate technology).

MM3P2. Students will reason and evaluate mathematical arguments.

ENGR-EC4 – Students will demonstrate a whole systems approach to engineering and problem solving.

- (a) Explain the functions engineers are responsible for as a team member in the design and development of technological products and processes.
- (b) Apply leadership skills to participation in design team activities.
- (c) Demonstrate a team approach in applying engineering design to the solution of a technological problem.
- (d) Apply continuous process improvement principles in designing a problem solution.
- (e) Demonstrate concurrent communication skills in developing a design solution.

Academic Standards:

SCSh6. Students will communicate scientific investigations and information clearly.

MM3P3. Students will communicate mathematically.

ENGR-EC5 – Students will apply engineering graphics and technical writing to communication of an engineering design.

- (a) Use multi-view projection and pictorial drawings to communicate design specifications.
- (b) Apply descriptive geometry and graphical vector analysis to the analysis of engineering design problems.
- (c) Apply accurate dimensions to a technical drawing, including size and geometric tolerances
- (d) Prepare a proposal for an engineering design project.
- (e) Document engineering design processes using an engineering design notebook.
- (f) Prepare a report of engineering design activities including a description of analysis, optimization, and selection of a final solution.

- (g) Demonstrate oral communication skills in reporting results of an engineering design activity.

Academic Standards:

SCSh6. Students will communicate scientific investigations and information clearly.

MM3P1. Students will solve problems (using appropriate technology).

MM3P3. Students will communicate mathematically.

MM3P5. Students will represent mathematics in multiple ways.

STEM Standards (common to all Engineering & Technology courses)

Nature of Technology

ENGR-STEM1 – Students will recognize the systems, components, and processes of a technological system.

- (a) Describe the core concepts of technology.
- (b) Identify the relationships among technologies along with connections to contemporary issues.
- (c) Apply lifelong learning strategies necessary to understand the characteristics and scope of technology.

Academic Standards:

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

SCSh7. Students analyze how scientific knowledge is developed.

MM3P4. Students will make connections among mathematical ideas and to other disciplines.

Technology and Society

ENGR-STEM2 – Students will identify the impact of engineering and technology within global, economic, environmental, and societal contexts.

- (a) Describe the social, economic, and environmental impacts of a technological process, product, or system.
- (b) Demonstrate ethical and professional behavior in the development and use of technology.
- (c) Explain the influence of technology on history and the shaping of contemporary issues.

Academic Standards:

SCSh7. Students analyze how scientific knowledge is developed.

MM3P4. Students will make connections among mathematical ideas and to other disciplines.

Design

ENGR-STEM3 – Students will design technological problem solutions using scientific investigation, analysis and interpretation of data, innovation, invention, and fabrication while considering economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints.

- (a) Demonstrate fundamental principles of design.
- (b) Design and conduct experiments along with analysis and interpretation of data.
- (c) Identify and consider realistic constraints relevant to the design of a system, component, or process.

Academic Standards:

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

SCSh3. Students will identify and investigate problems scientifically.

SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

SCSh8. Students will understand important features of the process of scientific inquiry.

MM3P1. Students will solve problems (using appropriate technology).

MM3P2. Students will reason and evaluate mathematical arguments.

Abilities for a Technological World

ENGR-STEM4 – Students will apply principles of science, technology, engineering, mathematics, interpersonal communication, and teamwork to the solution of technological problems.

- (a) Work cooperatively in multi-disciplinary teams.
- (b) Apply knowledge of mathematics, science, and engineering design.
- (c) Demonstrate strategies for identifying, formulating, and solving technological problems.
- (d) Demonstrate techniques, skills, and knowledge necessary to use and maintain technological products and systems.

Academic Standards:

SCSh3. Students will identify and investigate problems scientifically.

SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

SCSh6. Students will communicate scientific investigations and information clearly.

SCSh8. Students will understand important features of the process of scientific inquiry.

MM3P4. Students will make connections among mathematical ideas and to other disciplines.

The Designed World

ENGR-STEM5 – Students will select and demonstrate techniques, skills, tools, and understanding related to energy and power, bio-related, communication, transportation, manufacturing, and construction technologies.

- (a) Correctly and safely use common tools.
- (b) Describe strategies for selecting materials and processes necessary for developing a technological system or artifact.
- (c) Demonstrate fundamental materials processing and assembly techniques.
- (d) Evaluate the interdependence of components in a technological system and identify those elements that are critical to correct functioning.
- (e) Apply analytical tools to the development of optimal solutions for technological problems.

Academic Standards:

SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.

SCSh3. Students will identify and investigate problems scientifically.

SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

MM3P1. Students will solve problems (using appropriate technology).

MM3P2. Students will reason and evaluate mathematical arguments.

MM3P4. Students will make connections among mathematical ideas and to other disciplines.

Reading

ENGR-STEM6 – Students will enhance reading by developing vocabulary and comprehension skills associated with text materials, problem descriptions, and laboratory activities associated with engineering and technology education.

- (a) Reading in all curriculum areas.
- (b) Discussing books.
- (c) Building vocabulary knowledge.
- (d) Establishing context.

Academic Standards:

ELAALRC2 The student participates in discussions related to curricular learning in all subject areas.

ELAALRC3 The student acquires new vocabulary in each content area and uses it correctly.

ELAALRC4 The student establishes a context for information acquired by reading across subject areas.

Leadership Development

ENGR-STEM7 – Students will develop leadership and interpersonal problem-solving skills through participation in co-curricular activities associated with the Technology Student Association.

- (a) Demonstrate effective communication skills.
- (b) Participate in teamwork to accomplish specified organizational goals.
- (c) Demonstrate cooperation and understanding with persons who are ethnically and culturally diverse.

Academic Standards:

MM3P3. Students will communicate mathematically.

MM3P5. Students will represent mathematics in multiple ways.

SCSh6. Students will communicate scientific investigations and information clearly.

CTAE Foundation Skills

The Foundation Skills for Career, Technical and Agricultural Education (CTAE) are critical competencies that students pursuing any career pathway should exhibit to be successful. As core standards for all career pathways in all program concentrations, these skills link career, technical and agricultural education to the state's academic performance standards.

The CTAE Foundation Skills are aligned to the foundation of the U. S. Department of Education's 16 Career Clusters. Endorsed by the National Career Technical Education Foundation (NCTEF) and the National Association of State Directors of Career Technical Education Consortium (NASDCTEc), the foundation skills were developed from an analysis of all pathways in the sixteen occupational areas. These standards were identified and validated by a national advisory group of employers, secondary and postsecondary educators, labor associations, and other stakeholders. The Knowledge and Skills provide learners a broad foundation for managing lifelong learning and career transitions in a rapidly changing economy.

CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.