CAPS Engineering

UNIT 1: Engineering Design Process

ESSENTIAL QUESTION	BIG IDEAS
How can the engineering design process be applied to solve complex problems and innovate solutions?	• **Understanding the Engineering Design Process and its Phases** • **Applying Critical Thinking and Creativity in Engineering Design** • **Iterative Design and Continuous Improvement in Engineering Solutions**

GUIDING QUESTIONS

Content

- What are the key stages of the engineering design process, from problem identification and brainstorming to prototyping, testing, and refinement?
- How do engineers incorporate scientific principles, mathematics, and technology into the design and development of innovative solutions?
- What ethical considerations, environmental impacts, and sustainability factors should engineers address when designing products or systems?
- How do professional engineers use the design process in real world projects and applications?

Process

- How do students approach complex problems systematically, breaking them down into manageable tasks and generating multiple design concepts?
- What strategies do students use to evaluate and select the most viable design solutions based on criteria such as functionality, feasibility, cost-effectiveness, and user requirements?
- In what ways do students iterate on their designs, gathering feedback, analyzing results, and making iterative improvements to enhance performance and optimize outcomes?
- What feedback can be gained from professional engineers to teach students the importance of the design process?

Reflective

- How has your understanding of the engineering design process evolved throughout the

course, and how has it influenced your approach to problem-solving and innovation?
- What lessons have you learned from both successful and unsuccessful design projects, and how will you apply them to future engineering endeavors?
- What lessons can be learned while working in an engineering collaborative team?

FOCUS STANDARDS

Engineering Design & Development Course No. 21007

BENCHMARK 1: Design Process
Competencies

#	DESCRIPTION
1.1	Develop a problem statement from research.
1.2	Justify a problem through academic research.
1.3	Justify a problem through market research.
1.4	Research and document prior solution attempts.
1.5	Analyze prior solution attempts with a matrix.
1.6	Develop and document design requirements based on research.
1.7	Brainstorm and document concepts that solve a problem.
1.8	Build a mock-up that communicates a solution.
1.9	Use a matrix to justify the best solution.
1.10	Create a set of technical drawings that fully explain a design.
1.11	Identify and apply STEM Principles to a design.
1.12	Document the Viability of a Design.
1.13	Document a prototype build procedure.
1.14	Build a testable prototype.
1.15	Develop and document ways to test design requirements.
1.16	Test a prototype and document an analysis of the results.
1.17	Document an external evaluation of a prototype.

KEY LEARNING EXPERIENCES

- Introduction to the engineering design process through case studies, simulations, and hands-on design challenges.
- Brainstorming sessions and idea generation workshops to foster creativity and explore a range of design possibilities.
- Prototyping and testing of design concepts using various tools, materials, and techniques,

with an emphasis on rapid iteration and refinement.
- Collaboration with peers to critique and provide feedback on design solutions, promoting interdisciplinary perspectives and constructive critique.
- Presentation of design projects to peers, instructors, and industry partners, with opportunities for peer review, feedback, and improvement.
- Reflection on the design process and project outcomes through written reflections, group discussions, and self-assessment activities.

CAPS Engineering

UNIT 2: Applications in Engineering

ESSENTIAL QUESTION	BIG IDEAS
How can engineering principles be applied to address challenges and create innovations in various fields?	• **Exploring Specialized Areas of Engineering, including Manufacturing, Civil, Architectural, Digital Electronics, and Aerospace** • **Integrating STEM Disciplines to Solve Complex Problems** • **Engaging in Hands-on Projects and Real-World Applications**

GUIDING QUESTIONS

Content

- What are the key concepts, methods, and technologies used in specialized areas of engineering, such as manufacturing processes, structural design, circuitry, and aerospace systems?
- How do engineers analyze and assess the environmental, economic, and social impacts of engineering projects, considering factors such as sustainability, resource efficiency, and community resilience?
- What role does interdisciplinary collaboration play in engineering projects, and how can engineers communicate effectively with diverse stakeholders to achieve project goals?

Process

- How do students apply foundational engineering principles to real-world challenges and design projects within their chosen specialization areas?
- What strategies do students employ to plan, manage, and execute engineering projects effectively, including setting goals, allocating resources, and mitigating risks?
- In what ways do students collaborate with industry partners, experts, and community stakeholders to gather input, solicit feedback, and address project requirements and constraints?

Reflective

- How have your experiences in specialized areas of engineering deepened your understanding of STEM concepts and their practical applications?
- What insights have you gained from hands-on projects and real-world applications, and how will they inform your future career aspirations and academic pursuits?

FOCUS STANDARDS

Particular Topics in Engineering Course No. 21015

BENCHMARK 1: Project Work in Engineering
Competencies

#	DESCRIPTION
1.1	Define the scope of work (or topic to be researched) and appropriately document the process as it progresses.
1.2	Create and deliver a final presentation or portfolio of the results of the research or project.

KEY LEARNING EXPERIENCES

- Immersion in specialized areas of engineering through guest lectures, site visits, and hands-on workshops led by industry professionals and academic experts.
- Design and fabrication of engineering prototypes using advanced tools, equipment, and software platforms, with an emphasis on precision, accuracy, and attention to detail.
- Analysis and optimization of engineering systems and processes using mathematical modeling, simulation tools, and data-driven approaches.
- Field trips to manufacturing facilities, construction sites, research laboratories, and aerospace facilities to observe engineering practices and technologies in action.
- Collaboration with interdisciplinary teams to tackle complex engineering challenges, integrating knowledge and skills from multiple STEM disciplines.

CAPS Engineering

UNIT 3: Professional Skills Development through Career Exploration

ESSENTIAL QUESTION	BIG IDEAS
What are key professional skills needed to prepare future professionals in a career they are exploring?	• **Holistic Skill Development: Prioritize a diverse set of skills beyond technical expertise and including an entrepreneurial mindset.** • **Experiential Learning: Hands-on experiences, internships, apprenticeships, and project-based learning opportunities provide career exploration opportunities.** • **Mentorship and Networking: Facilitate mentorship programs and networking events to connect young professionals with experienced individuals in their field.**

GUIDING QUESTIONS

Content

- What are effective communication strategies and tools used in specific professions?
- Why are critical thinking, problem-solving and adaptability important?
- How can professional skill development bridge the gap between theoretical knowledge and practical application and enhance understanding of future career opportunities?
- How can mentors offer guidance, advice, and valuable insight most effectively?

Process

- How can students learn about their current strengths and opportunities for development?
- How can experiential learning opportunities holistically create opportunities to practice professional skills?

Reflective

- How does professional skill development foster lifelong learning and development?
- How can I take these skills and transfer them to post secondary and future career opportunities?

FOCUS STANDARDS

CTE Professionalism Standards

1.1 Act as a responsible and contributing citizen and employee.
1.2 Apply appropriate academic and technical skills.
1.4 Communicate clearly, effectively and with reason.
1.5 Consider the environmental,social and economic impacts of decisions.
1.6 Demonstrate creativity and innovation.
1.7 Employ valid and reliable research strategies.
1.8 Utilize critical thinking to make sense of problems and persevere in solving them.
1.9 Model integrity, ethical leadership and effective management.
1.10 Plan education and career path aligned to personal goals.
1.11 Use technology to enhance productivity.
1.12 Work productively in teams while using cultural/global competence.

CAPS Professional Profile

Skills: Communication, Collaboration, Time Management, Conflict Resolution, Critical Thinking, Interpersonal Relationship, Creativity, Leadership

Attributes: Adaptability, Curiosity, Self-awareness, Drive, Confidence, Enthusiasm, Resourcefulness, Integrity, Empathy

Actions: Networking, Interviewing, Goal Setting, Professional Manner

KEY LEARNING EXPERIENCES

- Experiential learning opportunities such as project presentations, apprenticeships, client projects and internships.
- Interview opportunities with community members.
- Mentorship events where students are connected to professionals in their chosen careers.
- Development of digital portfolios and resume building that are industry standard and can grow with students.