Maryland CTE Programs of Study

Engineering II (2025)

General requirements. This course is recommended for students in Grades 9-12. Students shall be awarded one credit for successfully completing this course. 1

1 General requirements. This course is recommended for students in Grades 9-12. Students shall be awarded one credit for successfully completing this course. 1

Introduction. 2

A Career and Technical Education (CTE) instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions. 2.A

B The Advanced Manufacturing Cluster emphasizes developing a skilled workforce in manufacturing and engineering fields. This cluster prepares students for careers that involve designing, creating, and maintaining systems and processes in manufacturing, utilizing modern technologies and engineering principles. 2.B

C The Engineering program of study emphasizes careers and educational pathways related to the design, development, and optimization of engineering solutions and processes. This includes disciplines such as mechanical, electrical, civil, and industrial engineering. The Engineering program of study covers essential topics such as the engineering design process (now with an expanded focus), computational thinking, materials science, manufacturing techniques, and solutions analysis. Students will engage in projects that involve iterative design, computational modeling, and critical thinking to address real-world challenges in engineering. The curriculum emphasizes the societal, environmental, and ethical impacts of engineering decisions, preparing students for careers in various industries and equipping them to be responsible innovators. Students will continue to examine societal impacts of engineering decisions, understand the role of ethics in effective decision-making, and develop essential professional skills such as communication and technical writing. 2.C

D The Engineering II course expands upon the foundations established in Engineering I. Students tackle complex projects, create and test 3D models using advanced CAD software, and develop problem-solving and analytical skills. The engineering design process is applied systematically across multi-phase, nterdisciplinary projects, emphasizing iteration, user feedback, and performance ›ptimization. Students also incorporate computational thinking and data-driven decision-making into engineering work. The course prepares students for

Skip to main content

industry-recognized certifications to enhance career readiness and introduces students to the social, ethical, and environmental implications of advanced engineering solutions. 2.D

E **Students will participate in at least two Career-Connected Education and Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.** 2.E

F **Students are encouraged to participate in extended learning experiences through aligned Career and Technical Student Organizations (CTSOs). CTSOs are a cocurricular requirement in the Carl D. Perkins Act, and alignment to CTSO activities is an expectation for CTE programs in the state of Maryland.** 2.F

Knowledge and Skills. 3

A **The student demonstrates the necessary skills for career development, maintenance of employability, and successful completion of course outcomes. The student is expected to:** 3.A

1. Identify and demonstrate positive work behaviors that enhance employability and job advancement, such as regular attendance, promptness, professional attire, and maintenance of a clean and safe work environment. 3.A.1
2. Demonstrate positive personal qualities such as initiative, flexibility, teamwork, active listening, and a willingness to learn in engineering contexts. 3.A.2
3. Employ effective written and verbal communication skills, including technical documentation, project reports, and design presentations consistent with industry standards. 3.A.3
4. Solve engineering problems using critical thinking and structured troubleshooting methodologies, focusing on complex solutions and processes. 3.A.4
5. Demonstrate leadership skills in managing engineering projects, including team coordination, task delegation, and collaborative problem-solving. 3.A.5
6. Implement safety procedures related to mechanical, electrical, and software tools, ensuring adherence to safety protocols, including proper equipment handling and use of personal protective equipment (PPE). 3.A.6
7. Exhibit an understanding of legal and ethical responsibilities in engineering, including adherence to industry regulations, intellectual property rights, and environmental impact assessments. 3.A.7
8. Demonstrate time-management skills and the ability to prioritize tasks efficiently, especially when working on multi-phase engineering projects. 3.A.8

B **The student identifies various career pathways in the engineering field. The student is expected to:** 3.B

1. Develop a career plan that includes the necessary education, certifications, job skills, and experience for specific roles in engineering design, manufacturing, or system integration. 3.B.1
2. Create a professional resume and portfolio that reflects engineering projects, certifications, skills, and academic achievements, showcasing technical proficiency and hands-on experience. 3.B.2

Skip to main content

3 Demonstrate effective interview skills for engineering roles, including preparation, articulation of project work, and communication of technical expertise. 3.B.3

4 Analyze current trends in engineering and technology fields, including the role of automation, AI, sustainability, and societal needs, in shaping future career opportunities. 3.B.4

C The student develops technology and digital literacy skills. The student is expected to: 3.C

1 Use technology as a tool for research, organization, communication, and problem-solving. 3.C.1

2 Use digital tools and platforms, including cloud-based services, simulation software, and engineering applications, to access, manage, and create engineering designs and project documentation. 3.C.2

3 Demonstrate proficiency in using emerging and industry-standard technologies relevant to engineering fields, such as robotics, automation, additive manufacturing (3D printing), and IoT (Internet of Things) systems. 3.C.3

4 Use advanced CAD tools (e.g., SolidWorks, Fusion 360) for 3D modeling, assembly design, and simulation, applying digital technology to solve engineering problems. 3.C.4

5 Understand ethical and legal considerations for technology use, including data protection, design ownership, and the environmental implications of engineering projects. 3.C.5

6 Apply computational thinking—including abstraction, decomposition, pattern recognition, and algorithmic thinking—to design and troubleshoot engineering solutions and software solutions. 3.C.6

D The student integrates core academic skills into engineering practices. The student is expected to: 3.D

1 Demonstrate the use of clear communication techniques, both written and verbal, that align with engineering project standards, including technical reports, design presentations, and project documentation. 3.D.1

2 Apply mathematical concepts such as trigonometry, algebra, and geometry in the analysis and design of engineering solutions. 3.D.2

3 Use scientific principles, such as thermodynamics, fluid mechanics, and electrical principles, in the design and analysis of engineering solutions and projects. 3.D.3

4 Apply data analysis and modeling techniques using computational tools (e.g., spreadsheets, programming environments) to inform design decisions and evaluate system performance. 3.D.4

5 Explore the impact of historical and emerging engineering innovations on society, culture, and the environment, considering both positive and unintended consequences. 3.D.5

6 Solve authentic engineering problems involving community stakeholders and create scalable and sustainable solutions. 3.D.6

Skip to main content

E **The student demonstrates the necessary skills to design, manage, and implement advanced engineering systems. The student is expected to:** 3.E

1. Identify and apply all phases of the Engineering Design Process (EDP) to develop, test, and refine innovative engineering solutions, using real-world data and stakeholder input to drive design iterations. 3.E.1
2. Design and implement engineering solutions, such as automation systems, robotics, and integrated mechanical-electrical systems, to solve real-world engineering challenges. 3.E.2
3. Configure and troubleshoot engineering solutions by applying scientific and mathematical principles. 3.E.3
4. Apply optimization techniques for system performance, efficiency, and cost-effectiveness, including energy management and resource allocation. 3.E.4
5. Incorporate ethical, legal, and environmental considerations into system design and decision-making processes, balancing innovation with societal responsibility. 3.E.5
6. Use computational models and simulations to evaluate the behavior and performance of complex engineering solutions under various scenarios. 3.E.6

F **The student demonstrates the necessary skills to integrate and manage engineering systems. The student is expected to:** 3.F

1. Integrate multiple engineering disciplines (such as mechanical, electrical, software, biomedical) into cohesive, functioning solutions that meet design specifications and operational requirements. 3.F.1
2. Configure and troubleshoot engineering solutions such as PLCs (Programmable Logic Controllers), automation networks, and sensor systems, adhering to industry standards. 3.F.2
3. Use advanced project management software to plan, track, and manage engineering projects, ensuring deadlines, budgets, and quality standards are met. 3.F.3
4. Apply techniques for improving system integration, ensuring seamless interaction between hardware, software, and user interfaces. 3.F.4
5. Use data acquisition tools and programming logic (e.g., Arduino, Python, sensor networks) to monitor and control integrated systems, applying feedback loops and logic-based decision-making. 3.F.5
6. Collaborate across disciplines to identify and resolve integration challenges that arise in diverse engineering contexts, including those related to ethics, accessibility, and sustainability. 3.F.6

G **The student demonstrates the necessary skills to implement and assess the sustainability of engineering solutions. The student is expected to:** 3.G

1. Design engineering solutions that minimize environmental impact, incorporating sustainable materials, energy-efficient processes, and waste reduction techniques. 3.G.1

Skip to main content

2 Apply lifecycle analysis to assess the environmental and economic sustainability of engineering projects, including sourcing, manufacturing, usage, and disposal stages. 3.G.2

3 Integrate renewable energy solutions into engineering designs, exploring solar, wind, and other green technologies for reducing carbon footprints. 3.G.3

H The student demonstrates the necessary skills to assess and improve engineering system reliability. The student is expected to: 3.H

1 Implement strategies to enhance system reliability, such as redundancy, fault-tolerant design, and predictive maintenance technologies. 3.H.1

2 Apply statistical methods such as regression analysis and quality control techniques (e.g., Six Sigma) to improve system performance and reduce failures. 3.H.2

3 Design and implement testing protocols for validating the reliability of engineering solutions and products, including stress testing, performance testing, and environmental testing. 3.H.3

4 Evaluate how engineering design choices affect long-term societal outcomes, including health, equity, and infrastructure resilience. 3.H.4

I The student integrates core academic skills into advanced engineering practices. The student is expected to: 3.I

1 Demonstrate effective communication skills in documenting and presenting engineering solutions, including detailed reports, project proposals, and design reviews. 3.I.1

2 Apply mathematical and computational techniques such as optimization, numerical methods, simulation modeling, and algorithmic analysis to solve complex engineering problems. 3.I.2

3 Use scientific and experimental methods in engineering research, including hypothesis testing, experimental design, and data analysis, to inform system improvements and innovations. 3.I.3

4 Investigate case studies of engineering failures and successes, identifying how decisions related to ethics, economics, and computational design impacted the outcomes. 3.I.4