

# Engineering Design II

## Course Compendium

### UNITS OF STUDY\*

Unit 1- Computer Aided Design

Unit 2- Prototyping Safety

Unit 3- Vehicle Design

Unit 4- Ergonomics & Industrial Design

Unit 5- Geographic Information Systems (GIS)

Unit 6- Alternative Energies

Unit 7- Design Team

Students in this course build upon the skills introduced in the Drawing and Design 1 course to solve higher level engineering design problems. Students utilize important science and mathematics concepts, common to most engineering disciplines, to develop more complex CAD drawings. Analyzing real life case studies allow students to enhance their basic skills for solving open-ended problems using the design process consisting of: documentation, material manipulation, internet research and mechanical drawing. Students in this class compete in problem solving and engineering design competitions.

### INTERDISCIPLINARY CONNECTIONS

#### **NJSLS Companion Standards Grades 9-12 (Reading & Writing in Science & Technical Subjects)**

**RST.9-10.1.** Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.

**RST.9-10.2.** Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

**RST.9-10.3.** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

**RST.9-10.4.** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.

**RST.9-10.5.** Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

**RST.9-10.6.** Determine the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

**RST.9-10.7.** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

**RST.9-10.8.** Determine if the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

**RST.9-10.9.** Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

*\*See individual units for Pacing Guide, NJSLS Standards, Transfer Skills, Enduring Understandings, Essential Questions, Learning Objectives, Key Vocabulary, Skills, Resources, & Assessments*

**RST.9-10.10.** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.

**NJSLSA.W4.** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

**NJSLSA.W5.** Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.

**NJSLSA.W7.** Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation.

**NJSLSA.W8.** Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

**NJSLSA.W9.** Draw evidence from literary or informational texts to support analysis, reflection, and research.

**WHST.9-10.1.** Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.

**WHST.9-10.2.** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

## **Science Connections**

**HS-ETS1-1.** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

**HS-ETS1-2.** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

**HS-ETS1-3.** Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

**HS-ETS1-4.** Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

## **21st Century Life and Careers**

**CRP1.** Act as a responsible and contributing citizen and employee.

**CRP2.** Apply appropriate academic and technical skills

**CRP4.** Communicate clearly and effectively and with reason.

**CRP5.** Consider the environmental, social and economic impacts of decisions.

**CRP6.** Demonstrate creativity and innovation.

**CRP7.** Employ valid and reliable research strategies.

**CRP8.** Utilize critical thinking to make sense of problems and persevere in solving them.

*\*See individual units for Pacing Guide, NJSLS Standards, Transfer Skills, Enduring Understandings, Essential Questions, Learning Objectives, Key Vocabulary, Skills, Resources, & Assessments*

**CRP11.** Use technology to enhance productivity.

**9.3.ST.1** Apply engineering skills in a project that requires project management, process control and quality assurance.

**9.3.ST.2** Use technology to acquire, manipulate, analyze and report data.

**9.3.ST.3** Describe and follow safety, health and environmental standards related to science, technology, engineering and mathematics (STEM) workplaces.

**9.3.ST.4** Understand the nature and scope of the Science, Technology, Engineering & Mathematics Career Cluster and the role of STEM in society and the economy.

**9.3.ST.5** Demonstrate an understanding of the breadth of career opportunities and means to those opportunities in each of the Science, Technology, Engineering & Mathematics Career Pathways.

**9.3.ST-ET.1** Use STEM concepts and processes to solve problems involving design and/or production.

**9.3.ST-ET.2** Display and communicate STEM information.

**9.3.ST-ET.4** Apply the elements of the design process.

**9.3.ST-ET.5** Apply the knowledge learned in STEM to solve problems.

**9.3.ST-ET.6** Apply the knowledge learned in the study of STEM to provide solutions to human and societal problems in an ethical and legal manner.

**9.3.ST-SM.1** Apply science and mathematics to provide results, answers and algorithms for engineering and technological activities.

**9.3.ST-SM.2** Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.

**9.3.ST-SM.4** Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.

## **Technology**

**8.1 Educational Technology:** All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

**8.1 Educational Technology: A. Technology Operations and Concepts:** Students demonstrate a sound understanding of technology concepts, systems and operations.

**8.1.12.A.CS1** Understand and use technology systems.

**8.1 Educational Technology: B. Creativity and Innovation:** Students demonstrate creative thinking, construct knowledge and develop innovative

products and process using technology.

**8.1.12.B.CS1** Apply existing knowledge to generate new ideas, products, or processes.

*\*See individual units for Pacing Guide, NJSLS Standards, Transfer Skills, Enduring Understandings, Essential Questions, Learning Objectives, Key Vocabulary, Skills, Resources, & Assessments*

**8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming:** All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

**8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming: A. The Nature of Technology: Creativity and Innovation** Technology systems impact every aspect of the world in which we live

**8.2.12.A.1** Propose an innovation to meet future demands supported by an analysis of the potential full costs, benefits, trade-offs and risks, related to the use of the innovation.

**8.2.12.A.2** Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.

**8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming: B. Technology and Society:** Knowledge and understanding of human, cultural and societal values are fundamental when designing technological systems and products in the global society

**8.2.12.B.2** Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation and maintenance of a chosen product.

**8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming: C. Design:** The design process is a systematic approach to solving problems.

**8.2.12.C.5** Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.

**8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming: D. Abilities for a Technological World:** The designed world is the product of a design process that provides the means to convert resources into products and systems.

**8.2.12.D.3** Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.

## GENERAL CONSIDERATIONS FOR DIVERSE LEARNERS

English Language Learners	Students Receiving Special Education Services	Advanced Learners
<ul style="list-style-type: none"> <li>- Personal glossary</li> <li>- Text-to-speech</li> <li>- Extended time</li> <li>- Simplified / verbal instructions</li> <li>- Frequent breaks</li> </ul> <p><a href="#">WIDA Can Do Descriptors for Grade 9-12</a>  <a href="#">WIDA Essential Actions Handbook</a>  <a href="#">FABRIC Paradigm</a>  <a href="#">Wall Township ESL Grading Protocol</a></p> <p>*Use WIDA Can Do Descriptors in coordination with Student Language Portraits (SLPs).</p>	<ul style="list-style-type: none"> <li>- Small group/One to one</li> <li>- Additional time</li> <li>- Review of directions</li> <li>- Student restates information</li> <li>- Space for movement or breaks</li> <li>- Extra visual and verbal cues and prompts</li> <li>- Preferential seating</li> <li>- Follow a routine/schedule</li> <li>- Rest breaks</li> <li>- Verbal and visual cues regarding directions and staying on task</li> <li>- Checklists</li> <li>- Immediate feedback</li> </ul> <p>Students receiving Special Education programming have specific goals and objectives, as well as accommodations and modifications outlined within their Individualized Education Plans (IEP) due to an identified disability and/or diagnosis. In addition to exposure to the general education curriculum, instruction is differentiated based upon the student's needs. The IEP acts as a supplemental curriculum guide inclusive of instructional strategies that support each learner.</p> <p><a href="#">Considerations for Special Education Students 6-12</a>  <a href="#">National Center on Universal Design for Learning - About UDL</a>  <a href="#">UDL Checklist</a>  <a href="#">UDL Key Terms</a></p>	<ul style="list-style-type: none"> <li>- Use of high level academic vocabulary/texts</li> <li>- Problem-based learning</li> <li>- Preassess to condense curriculum</li> <li>- Interest-based research</li> <li>- Authentic problem-solving</li> <li>- Homogeneous grouping opportunities</li> </ul> <p><a href="#">Knowledge and Skill Standards in Gifted Education for All Teachers Pre-K-Grade 12 Gifted Programming Standards</a>  <a href="#">Gifted Programming Glossary of Terms</a></p>
		<b>Students with 504 Plan</b>
		Teachers are responsible for implementing designated services and strategies identified on a student's 504 Plan.
At Risk Learners / Differentiation Strategies		
<ul style="list-style-type: none"> <li>Alternative Assessments</li> <li>Choice Boards</li> <li>Games and Tournaments</li> <li>Group Investigations</li> <li>Learning Contracts</li> <li>Leveled Rubrics</li> <li>Literature Circles</li> <li>Multiple Texts</li> <li>Personal Agendas</li> <li>Homogeneous Grouping</li> </ul>	<ul style="list-style-type: none"> <li>Independent Research &amp; Projects</li> <li>Multiple Intelligence Options</li> <li>Project-Based Learning</li> <li>Varied Supplemental Activities</li> <li>Varied Journal Prompts</li> <li>Tiered Activities/Assignments</li> <li>Tiered Products</li> <li>Graphic Organizers</li> <li>Choice of Activities</li> <li>Mini-Workshops to Reteach or Extend</li> <li>Think-Pair-Share by readiness or interest</li> <li>Use of Collaboration of Various Activities</li> </ul>	<ul style="list-style-type: none"> <li>Jigsaw</li> <li>Think-Tac-Toe</li> <li>Cubing Activities</li> <li>Exploration by Interest</li> <li>Flexible Grouping</li> <li>Goal-Setting with Students</li> <li>Homework Options</li> <li>Open-Ended Activities</li> <li>Varied Product Choices</li> <li>Stations/Centers</li> <li>Work Alone/Together</li> </ul>

*\*See individual units for Pacing Guide, NJSL Standards, Transfer Skills, Enduring Understandings, Essential Questions, Learning Objectives, Key Vocabulary, Skills, Resources, & Assessments*