Capstone in Engineering

Course Compendium

The purpose of the Capstone in Engineering is to provide an in-depth design experience taking an idea from conception through the development and construction of a solution to a problem in the form of a product, model or prototype. In this course, students will spend the better part of the year engaged in the Engineering Design process to develop a solution to a unique problem with a Design, Technological and/or Engineering focus. The students should be passionate about pursuing a career and/or higher education associated within the STEM (Science, Technology, Engineering, Mathematics) fields and/or Entrepreneurialism. Projects may take the form of a physical or web-based product or system (can be a new invention or an innovation/personalization of an existing technology) which they will develop, document and present during the spring. The course will focus on applying and documenting the engineering design process through the use of engineering logs, portfolios, digital journals, technical reports, and presentations.

UNITS OF STUDY*

Unit 1-The Engineering Design Process
Unit 2- Conducting and Presenting Research
Unit 3- Project Management
Unit 4- Mockups and Prototyping
Unit 5- Advanced Prototyping
Unit 6- Documentation
Unit 7- Product Presentation

INTERDISCIPLINARY CONNECTIONS

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

RST.11-12.1. 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.11-12.4. 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 11-12 texts and topics.
RST.11-12.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
RST.11-12.9. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

NJSLSA.W4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
NJSLSA.W6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

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

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.11-12.1. Write arguments focused on discipline-specific content.
WHST.9-10.2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
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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.
CRP11. Use technology to enhance productivity.
CRP12. Work productively in teams while using cultural global competence

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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.3 Analyze the impact that science and mathematics has on society.
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.

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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**
- Personal glossary - Text-to-speech - Extended time - Simplified / verbal instructions - Frequent breaks WIDA Can Do Descriptors for Grade 9-12 WIDA Essential Actions Handbook FABRIC Paradigm Wall Township ESL Grading Protocol *Use WIDA Can Do Descriptors in coordination with Student Language	- Small group/One to one - Additional time - Review of directions - Student restates information - Space for movement or breaks - Extra visual and verbal cues and prompts - Preferential seating - Follow a routine/schedule - Rest breaks - Verbal and visual cues regarding directions and staying on task - Checklists - Immediate feedback Students receiving Special Education programming have specific goals and objectives, as well as	- Use of high level academic vocabulary/texts - Problem-based learning - Preassess to condense curriculum - Interest-based research - Authentic problem-solving - Homogeneous grouping opportunities Knowledge and Skill Standards in Gifted Education for All Teachers Pre-K-Grade 12 Gifted Programming Standards Gifted Programming Glossary of

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Portraits (SLPs).	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. Considerations for Special Education Students 6-12 National Center on Universal Design for Learning - About UDL UDL Checklist UDL Key Terms	Terms **Students with 504 Plan** Teachers are responsible for implementing designated services and strategies identified on a student's 504 Plan.

At Risk Learners / Differentiation Strategies

Alternative Assessments	Independent Research & Projects	Jigsaw
Choice Boards	Multiple Intelligence Options	Think-Tac-Toe
Games and Tournaments	Project-Based Learning	Cubing Activities
Group Investigations	Varied Supplemental Activities	Exploration by Interest
Learning Contracts	Varied Journal Prompts	Flexible Grouping
Leveled Rubrics	Tiered Activities/Assignments	Goal-Setting with Students
Literature Circles	Tiered Products	Homework Options
Multiple Texts	Graphic Organizers	Open-Ended Activities
Personal Agendas	Choice of Activities	Varied Product Choices
Homogeneous Grouping	Mini-Workshops to Reteach or Extend	Stations/Centers
	Think-Pair-Share by readiness or interest	Work Alone/Together
	Use of Collaboration of Various Activities	

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