Washington Township Public Schools
COURSE OF STUDY – CURRICULUM GUIDE

Course: Advanced Design Applications in Engineering

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Description:

Engineering Design Systems is a full year course where students are instructed in Engineering design fundamentals, structural systems, mechanical systems, electronic systems, and pneumatic systems. Students will learn how to communicate design ideas using sketches, orthographic projections, renderings, mockups, and presentation models. Advanced parametric, solid modeling software techniques are applied to design problems. Students are given design problems which require the application of critical thinking, research and investigation, and the application of math, science and communication skills. They will also be given the opportunity to compete in the Technology Student Association Competition.

Jack McGee: *Interim Assistant Superintendent for Curriculum & Instruction*
Gretchen Gerber: *Director of Elementary Education*
Cleve Bryan: *Interim Director of Secondary Education*

Written: August, 2015
Revised:
BOE Approval: SEPTEMBER, 2015

DEMONSTRABLE PROFICIENCIES

COURSE TITLE: Advanced Design Applications in Engineering

1. CLASSWORK REQUIREMENTS

A. Students must be attentive and effectively following directions
B. Students must exhibit responsibility by bringing the necessary materials to class
C. Student resource materials should be legible, well organized, and attention to detail must be noted
D. Homework is a regular requirement
E. Short-term problem applications will be assigned when appropriate
F. A culminating long-term business simulation will be assigned during the last marking period and is a major part of the graded work for the course
G. Quizzes and tests are teacher prepared instruments and usually administered after each chapter introduction of a unit
H. Follow all rules and regulations of the classroom and lab facilities.
I. Be responsible in maintaining equipment that the students are being trained with.
J. Be prepared for class with an engineering journal, lab book and writing equipment necessary for the assignments and work that may be given daily.
K. Demonstrate an understanding of basic skills in reading, writing, and mathematics.
L. Know and apply appropriate safety rules and regulations and demonstrate the safe operation of equipment.
M. Become familiar with computer software, engineering terms, and systems

2. ATTITUDE & BEHAVIOR

A. Behavior and class attendance must conform to Board of Education policy.
B. Students must display a readiness to work.
C. Students must actively participate in class through the maintenance of a notebook and teacher directed patterning activities of concepts.
D. Students must adhere to scheduled deadlines.
E. Students must follow oral and written directions accurately.
F. Tolerate routine work without displaying frustration.
G. Demonstrate respect for all persons present in the classroom
H. Abide by the R2361 Technology / Internet Acceptable Use Agreement.

I. CONFORM TO ALL BOARD OF Ed policies
J. Assume responsibility for making arrangements with the teacher to make up any work missed due to absence.
K. Participate in class discussions and respect others' opinions.
L. Complete assignments in a timely manner.
M. Complete On-line reading assignments and prepare for upcoming activities and assignments.
N. Bring required materials to class on a daily basis.
O. Abide by and follow Internet Copyright laws.

3. COURSE OBJECTIVES/OVERVIEW

- **COURSE CONTENT**: This course is a full year course for 9-12 grade students who wish to be exposed to engineering design concepts. The course covers:
- Classroom equipment and orientation
- Personal and equipment safety
- What is Engineering
- Career opportunities
- Evolution and History
- Engineering Drafting Systems
- Basic Engineering Design
- Sketching
- Parametric CADD for Engineering
- Structural Systems
- Mechanical Systems
- Electronic Systems
- Pneumatic Systems
- Testing and evaluation

A. Engineering Models

B. SKILLS

A. Organization and self-motivation is required for problem application work.
B. Discuss the advantages and disadvantages of the different careers surrounding engineering.
C. Identify different types of engineering systems.
D. Design an object based on a given set of specifications.
E. Identify and work with common engineering materials in their designs.

F. Discuss the roles of technology in our society.
G. Maintain an ethical approach to engineering design.

C. APPRECIATION OF CONCEPTS

a. An appreciation for organization and orderliness of one's materials to enhance the expediency of performing a task.
b. An ability to analyze and reproduce select information.
c. The ability to adjust quickly to equipment, program, and procedure changes.
d. Appreciate how the initial calculation of inaccurate data affects several other areas of problem solving.
e. Appreciate the need of an iterative process for optimal design results.
f. Appreciate the value of modern, parametric software in the solution of engineering problems.
g. Appreciate the role accurate documentation plays in modeling and prototyping.
h. Appreciate the time required to insure a design reaches its intended goals.
i. Appreciate the benefit of teamwork in the solution of complex design problems.

4. ATTENDANCE

Attendance: Refer to Board of Education Policy

5. GRADING PROCEDURES

A. Assessments- 30%

B. Assignments (Classwork/projects/homework) 60%

C. Conduct (Participation/Preparation) 10%

Semester 1 Grade (S1) is calculated: (50% of Y1) MP1=20%, MP2= 20%, Mid-term(X1) exam= 10%

Semester 2 Grade (S2) is calculated: (50% of Y1) MP3= 20%, MP4= 20%, Final (X2) exam = 10%

Final Grade (Y1) is calculated: S1 + S2 = Y1

MAJOR UNITS OF STUDY

Course Title: Advanced Design Applications in Engineering

I. The World of Engineering
II. Safety and Coursework in the Engineering lab
III. Engineering Design Fundamentals
IV. Structural Systems
V. Mechanical Systems
VI. Electronic Systems
VII. Pneumatic Systems
VIII. Materials, Testing and, Prototyping

UNIT OVERVIEW

Course Title: Advanced Design Applications in Engineering

Unit #: Unit 1 **Unit Title:** The World of Engineering

Unit Description and Objectives:
This unit introduces the student to the course and facilities, the world of engineering, engineering careers, basic designs, and primary considerations in the planning and designing of an object or device.

Essential Questions and Enduring Understandings:

Essential Questions:	**Enduring Understandings/Generalizations Students will understand that:**	**Guiding Questions**
1. What is engineering?	1. The study of engineering is the study of the human quest for solutions.	1. Are there any products in your home that have not been engineered in some aspect of their design or manufacture?
2. What are the types of jobs associated with engineering?	2. Engineering technology is evident throughout history and is reflected in careers in the areas of design.	2. What is the difference between an industrial designer and an engineer?
3. In what kind of environment does an engineer operate?	3. Engineers operate in a variety of environments from offices to manufacturing assembly lines.	3. Would an engineer need to work in the field at any point?
4. How is engineering related to technology and science?	4. Science and math are tools that an engineer applies toward the solution of design problems.	4. What types of math and science skills does an engineer need to solve problems?
5. What are the responsibilities of the engineer?	5. Engineers have an ethical responsibility to the society in which they operate.	5. What happens if an engineer's design fails?

CURRICULUM UNIT PLAN

Course Title/Grade: Advanced Design Applications in Engineering

Unit Number/Title: **Unit I-** The World of Engineering

Conceptual Lens: Introduction to the study of engineering and its relationship to the designed world

Appropriate Time Allocation (# of Days)**:** 5

Primary Content Standards referenced With Cumulative Progress Indicators			
8.1.12.A3,4	8.1.12.D.5	8.1.12.E.1	
8.1.12.F.12	8.2.12.B.4	8.2.12.C.5	
8.1.12.A3,4	8.1.12.D.5		
	8.1.12.E.1		

Topics/Concepts (Incl. time / # days per topic)	**Critical Content (Students Will Know:)**	**Skill Objectives (Students Will Be Able To:)**	**Instructional/Learning Activities & Interdisciplinary Connections**	**Instructional Resources**	**Technology & 21st C Skills Integration (Specify)**	**NJSLS w/ CPI Reference**	**Evaluation/ Assessment:**
1. Engineering careers 2. The Engineering Lab 3. The Technological Age 4. Defending Technology 5. Systems a. Inputs b. Process c. Outputs 6. The Relationship Between Engineering, Technology, and Science 7. Impacts of Engineering 8. Engineering and the Earth's Resources	1. There are four main areas of engineering study 2. Layout and function of the lab and its resources 3. The relationship between the industrial revolution and the technological age. 4. The pros and cons of technology 5. How a systems model works 6. The symbiotic relationship between science, technology, and engineering. 7. Four types of engineering impacts: a. Anticipated positive	1. List the four types of engineering 2. Identify the various resources of the lab 3. Discuss the role of engineering on the industrial, information and technological ages 4. Mount a cogent defense of technology while recognizing its potential for negative outcomes 5. Describe the systems approach to a technological product 6. The four types of impacts that may occur with any	1. Students access the Occupational Outlook Handbook and research engineering related careers 2. Students trace a modern day artifact to its industrial revolution start. An example would be the modern diesel-electric locomotive to its steam-powered counterpart 3. Students label the systems of an automobile 4. Students list all the scientific concepts applied to modern passenger aircraft 5. Students list the four types of impacts related to nuclear power	Functioning internet Inventor software	NJSLS 8.1.12.A3,4 8.1.12.D.5 8.1.12.E.1 8.1.12.F.12 8.2.12.B.4 8.2.12.C.5 9.1.12.A.3 9.1.12.A.6 9.2.12.C.3,6 9.3.12FN-ACT.1-4 CRP1-12 9.3.12.AC.4 9.3.12.AC.5 9.3.12.AC.7 Technology Foundation Standards for Students (NETS) 1 (1,2,3) 2 (1,2,3,4,5) 3 (1,4) 4 (2,4) 5 (3,4) 6 (4)	NJSLS: Gr.11-12, RST 1 NJSLS: Gr.11-12, RST 3 NJSLS: Gr.11-12, RST 4 NJSLS: Gr.11-12, RST 8 NJSLS: Gr.11-12, RST 10 NJSLS: Gr.11-12, WHST 6 NJSLS: Gr.11-12, WHST 10 NJSLS N-Q.1-3	**Formative Assessment:** 1. Teacher observes student progress on accessing the OOH and recording information on given occupations. **Summative Assessment** 1. Students give presentation on the type of occupation, educational requirements, median salary, and working conditions

Topics/Concepts (Incl. time / # days per topic)	**Critical Content (Students Will Know:)**	**Skill Objectives (Students Will Be Able To:)**	**Instructional/Learning Activities & Interdisciplinary Connections**	**Instructional Resources**	**Technology & 21st C Skills Integration (Specify)**	**NJSLS w/ CPI Reference**	**Evaluation/ Assessment:**
9. Engineering software	b. Anticipated negative c. Unanticipated positive d. Unanticipated negative 8. How engineering influences how the earth's resources are accessed and used.	given engineering endeavor 7. The relationship between the field of engineering and the use of the earth's resources 8. Apply parametric software toward the solution of a technological problem	6. Teacher lead discussion on the role of engineering and the earth's resources 7. Students open and use Inventor software to reacquaint themselves with its operation		7 (1,2,5,6) 8 (4,5) 9 (2,5,6) 10 (3,5) P21 Framework 1. Communication and Collaboration Information Literacy		

Unit Modifications for Special Population Students:

Struggling Learners	Gifted and Talented Students (Challenge Activities)	English Language Learners	Learners with an IEP	Learners with a 504
• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org	• Refer to page four in the Parent and Educator Guide to Section 504 to assist in the development of appropriate plans.

UNIT OVERVIEW

Course Title: Advanced Design Applications in Engineering

Unit #: Unit 2 **Unit Title:** **Safety and Coursework in the Engineering Lab**

Unit Description and Objectives:
Students are instructed on rules, conduct, expectations and safety in the lab. The safety instruction of this unit is repeated throughout the year as needed for the different design prototyping and modeling applications.

Essential Questions and Enduring Understandings:

Essential Questions:	**Enduring Understandings/Generalizations Students will understand that:**	**Guiding Questions**
1. Why do different tools have different cutting surfaces?	1. The varying molecular makeup of materials requires different cutting tools to achieve material separation.	1. How do end mill cuts differ from how a circular saw blade cuts? 1.2. Is a file considered a cutting tool? Sand paper?
2. What is the most prevalent injury in the design lab throughout the state?	2. Lacerations are the leading injury in design labs throughout the state.	2. What tool is most responsible for lacerations in the design lab?
3. How does the grain direction influence the type of tool used to cut it?	3. Using the correct tool for material separation is contingent upon the material and its grain direction.	3.1. What power tools could be used for rip cuts? 3.2. What power tools could be used for cross cuts?
4. Can you use the milling machine to bore holes?	4. There are multiple tools used for boring operations depending on the tolerances required and the type of material being bored.	4. Can 6061 aluminum be bored on the drill press?
5. Why should the miter saw never be used in conjunction with the rip fence on the table saw?	5. Kickbacks are caused by the binding of the work piece between the moving blade and a stationary guiding surface.	5. What tool would be a better choice for repeating the same dimension cross-cut?
6. Cross-cutting is most efficiently accomplished with what machine?	6. The miter saw is best suited for cross-cutting.	6. What is another name for the power miter saw?
7. How do you prevent bit "drift" when drilling a hole in any material?	7. Use of a center punch is crucial when using the drill press to bore holes accurately.	7. Does a drill bit have a "point"?
8. How can you cut the power to all the lab's machines at once?	8. Emergency power shut-offs are located by each of the doorways in the lab.	8. What could you do to stop a machine that is putting the operator in a dangerous circumstance?
9. Why shouldn't you talk to anyone while they are operating a power tool?	9. Distractions are likely to cause the operator of a machine to be injured.	9. Is it ok to talk to someone while they are using a power tool?
10. Why is it important to know where to locate yourself for each of the different types of emergencies?	11. The locations and procedures vary according to the type of emergency.	10. What is the difference between a lockdown and a shelter in place?

CURRICULUM UNIT PLAN

Course Title/Grade: Advanced Design Applications in Engineering

Unit Number/Title: **Unit 2- Safety and Coursework in the Engineering lab**

Conceptual Lens: The course has classroom and lab safety requirements which need to be followed throughout the year.

Appropriate Time Allocation (# of Days)**:** 5

Primary Content Standards referenced With Cumulative Progress Indicators			
8.1.12.A3,4	8.1.12.F.12	8.1.12.E.1	
8.1.12.D.5	9.1.12.A.3		
9.1.12.A.6			

Topics/Concepts (Incl. time / # days per topic)	**Critical Content (Students Will Know:)**	**Skill Objectives (Students Will Be Able To:)**	**Instructional/Learning Activities & Interdisciplinary Connections**	**Instructional Resources**	**Technology & 21st C Skills Integration (Specify)**	**NJSLS w/ CPI Reference**	**Evaluation/ Assessment:**
1) Egress/Evacuations a) Fire Drill b) Evacuation c) Lock-down d) Intruder 2) Classroom expectations 1. Behavior 2. Grading procedure 3. Attendance 4. Lateness 5. Housekeeping 3) Tools of the Design Lab a) Power Tools Miter saw Table saw Circular saw Band saw Drill press Mill Lathe Jointer Belt sander Disc sander	1. What procedures to follow during the four types of drills/emergency situations 2. What course and classroom behaviors expectations are 3. Safe operating procedures for the following: a) Miter saw b) Table saw c) Circular saw d) Band saw e) Drill press f) Mill g) Lathe h) Jointer i) Belt sander j) Disc sander k) Cross-cut saw l) Rip saw m) Utility knife	1. Locate and show up to all emergency locations 2. Explain the behavioral and course expectations 3. Select and properly use the correct tool to cross-cut and rip a piece of lumber 4. Use the milling machine to bring a piece of material to the required dimensions within 0.005" 5. Use the lathe to bore and turn down aluminum and steel to design tolerances. 6. Select and safely use the correct	1. Students report to egress areas to familiarize themselves with procedures and areas of egress and lockdowns 2. This unit is designed to be applied throughout the year on a variety of projects/designs. There is no one activity that is identified as the delivery vehicle for these concepts. 3. Set up and mill a piece of material to a given dimension with a tolerance of 0.0025"+/- 4. Apply all other hand and power tools as required throughout the year to complete individual prototypes and models of design solutions.	1. Tools and machines of H-110 and H-111 2. Aluminum, steel, wood and various other structural materials as needed for individual design solutions. 3. Internet	NJSLS 8.1.12.A3,4 8.1.12.D.5 8.1.12.E.1 8.1.12.F.12 9.1.12.A.3 9.1.12.A.6 9.2.12.C.3,6 9.3.12FN-ACT.1-4 CRP1-12 Technology Foundation Standards for Students (NETS) 1 (1,2,3) 2 (1,2,3,4,5) 3 (1,4) 4 (2,4) 5 (3,4) 6 (4) 7 (1,2,5,6) 8 (4,5) 9 (2,5,6) 10 (3,5)	NJSLS: Gr.11-12, RST 1 NJSLS: Gr.11-12, RST 3 NJSLS: Gr.11-12, RST 4 NJSLS: Gr.11-12, RST 8 NJSLS: Gr.11-12, RST 10 NJSLS: Gr.11-12, WHST 6 NJSLS: Gr.11-12, WHST 10 NJSLS N-Q.1-3	**Formative Assessment:** 2. Safety Quiz **Summative Assessment** 2. Students are observed using tools and machines while following all applicable safety requirements 3. Midterm EXAM

Topics/Concepts (Incl. time / # days per topic)	**Critical Content (Students Will Know:)**	**Skill Objectives (Students Will Be Able To:)**	**Instructional/Learning Activities & Interdisciplinary Connections**	**Instructional Resources**	**Technology & 21st C Skills Integration (Specify)**	**NJSLS w/ CPI Reference**	**Evaluation/ Assessment:**
b) Hand tools Cross-cut saw Rip saw Utility knife x-acto knife Screwdrivers c) Pneumatic tools Brad nailer Nailer Pin nailer d) Special tools CNC router 3-D printer	n) x-acto knife o) Screwdrivers p) Brad nailer q) Framing nailer r) Pin nailer s) CNC router t) 3-D printer	hand or power tool for a given operation. 7. Use the design software to output files to the CNC router and 3-D printer. 8. Use all pneumatic tools safely					

Unit Modifications for Special Population Students:

Struggling Learners	Gifted and Talented Students (Challenge Activities)	English Language Learners	Learners with an IEP	Learners with a 504
• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in	• Refer to page four in the Parent and Educator Guide to Section 504 to assist in the development of appropriate plans.

			learning opportunities. The framework can be viewed here www.udlguidelines.cast.org	

UNIT OVERVIEW

Course Title: Advanced Design Applications in Engineering

Unit #: Unit 3 **Unit Title:** **Engineering Design Fundamentals**

Unit Description and Objectives:
In this unit students explore the relationship between traditional drafting and parametric design or CADD. Additionally students explore more advanced modeling techniques available in the Inventor software package. Workflow efficiencies are investigated with an eye toward improving the design and solution modeling processes. Concepts and content of this unit are used throughout the course as students drill down into the increasing levels of complexity in both their design work and Inventor use.

Essential Questions and Enduring Understandings:

Essential Questions:	**Enduring Understandings/Generalizations Students will understand that:**	**Guiding Questions**
1. What are the three principal views?	1. The three main views are the front, top and right side views of an object as viewed through mutually perpendicular planes.	1. What does the term "mutually perpendicular" mean?
2. Which of the three views is the most important in a set of engineering drawings?	2. What is defined as the front view of an object is the most important view.	2. Why is the front view of an object important?
3. How do you read an architect's scale?	3. An architect's or engineer's scale has 6 scales and can be read from left to right or right to left depending on the scale being used.	3. On which scale would 1:50 be found?
4. What Is CADD?	4. CADD is an acronym for Computer Aided Drawing and Design	5. How is CADD similar to parametric design?
6. Why use CADD	5. CADD has evolved to allow a much more powerful and efficient workflow in the design process.	5. How have computers improved workflow efficiency?
7. How is traditional drafting related to parametric design software?	6. CADD practices evolved from 19th century drafting conventions and the conventions of drafting are still applicable to the view arrangements in CADD.	7. What industry advanced the practice of drafting or mechanical drawing?
8. How are the spatial relationships in geometry related to parametric design software?	8. Cartesian and polar coordinates as well as geometric relationships in three dimensional space all use geometric algorithms to define points in space.	6. What axes are used in the Cartesian coordinate system?
9. What is the difference between part, assembly, drawing and presentation files in Inventor?	9. Each of the four types of files are used to fully describe an objects shape and size. The part file is used for describing individual parts and their geometry within the part file; assembly files describe geometric relationships between parts; drawing files document the geometry of both part	7. What type of drawing is typically included in a product's assembly directions?

	and assembly files; presentation files allow the creation of exploded views of assembly files.	
10. How is creating solid bodies in Inventor similar to creating an assembly?	10. Solid body creation allows for mating parts to be created in a part file and then be derived to individual parts.	8. What does it mean to derive a part?
11. Why can't dynamic simulation be used in an Inventor part file?	11. Dynamic simulation requires an assembly to allow for the relationship between parts to be analyzed.	9. Is there a way to detect collisions between moving parts in Inventor?
12. What is the purpose of the stress analysis tool?	12. The stress analysis tool allows for the designer to see a graphic representation of how various geometric variables impact the design.	10. How can stresses be evaluated when part geometry is altered?
13. Why are constraints important in Inventor modeling?	13. Constraints dictate how part geometry relates to each other, how parts relate to each other in assemblies and how those relationships are documented.	11. How can we control the geometric relationships between sketch geometry and parts?
14. What tool palette is designed for injection molded parts?	14. The plastic tool palette allows for tools specific to molded parts to be used.	12. What types of tools are useful when creating injection molded parts?
15. How can a part be made to fit a variety of circumstances in Inventor?	15. Parts can be made in iparts allowing for multiple variables to be assigned to one part file allowing multiple iterations of the same part.	13. How can one part file be made to allow for multiple iterations of that part to be brought into an assembly?

CURRICULUM UNIT PLAN

Course Title/Grade: Advanced Design Applications in Engineering

Unit Number/Title: **Unit 3- Engineering Design Fundamentals**

Conceptual Lens: Modern design software traces its roots to traditional drafting/mechanical drawing. Modern software allows for improved workflow along with enhanced analytical capabilities which extend the capabilities of the engineer.

Appropriate Time Allocation (# of Days)**:** 40

Primary Content Standards referenced With Cumulative Progress Indicators

8.2.12.A.1	8.2.12.C.3		8.2.12.B.31	8.2.12.F.1
			8.2.12.B.3	
8.2.12.D.1	8.2.12.E		8.2.12.C.3	

Topics/Concepts (Incl. time / # days per topic)	**Critical Content (Students Will Know:)**	**Skill Objectives (Students Will Be Able To:)**	**Instructional/Learning Activities & Interdisciplinary Connections**	**Instructional Resources**	**Technology & 21st C Skills Integration (Specify)**	**NJSLS w/ CPI Reference**	**Evaluation/ Assessment:**
A. Drafting Foundations i) Orthographic Projection ii) Drawing Conventions B. CADD applications Computer aided drawing i) AutoCAD ii) Vector Works Parametric design software i) Solid Works ii) Pro Engineer iii) Inventor C. Inventor Parametric Software i) Part files a) Sketches b) Constraints c) Features d) Solid bodies ii) Assembly files a) Part placement b) Constraints c) Stress analysis d) Dynamic Simulation	1. The three main views are the front, top and right side views of an object as viewed through mutually perpendicular planes 2. What is defined as the front view of an object is the most important view. 3. An architect's or engineer's scale has 6 scales and can be read from left to right or right to left depending on the scale being used. 4. CADD is an acronym for Computer Aided Drawing and Design 5. CADD has evolved to allow a much more powerful and efficient workflow in the design process. 6. CADD practices evolved from 19th century drafting	1. Describe the relationship between traditional drafting and CADD 2. List the three main views used in engineering documentation whether drafting or CADD based 3. Describe the different uses of the four Inventor file types 4. Describe the similarities between all	1. Students create the parts for, assemble and create the requisite files for an air powered engine 2. Students design a part for injection molding Interdisciplinary Connections: *Physics of air engine; rotational mass; conversion of*	1. Functioning intranet and internet 2. Inventor Software 3. Plans for air engine	NJSLS 8.1.12.A3, 4 8.1.12.D.5 8.1.12.E.1 8.1.12.F.1 2 9.1.12.A.3 9.1.12.A.6 9.2.12.C.3, 6 9.3.12FN-ACT.1-4 CRP1-12 Technology Foundation Standards for	NJSLS: Gr.11-12, RST 1 NJSLS: Gr.11-12, RST 3 NJSLS: Gr.11-12, RST 4 NJSLS: Gr.11-12, RST 8 NJSLS: Gr.11-12, RST 10 NJSLS: Gr.11-12, WHST 6 NJSLS: Gr.11-12, WHST 10	**Formative Assessment:** 1. Student part file creation 2. Student assembly creation 3. Student drawing file creation 4. Student presentation file presentation **Summative Assessment**

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
e) Designing for injection molding iii) Drawing files a) View placements b) Scale c) Hidden lines d) Auxiliary views e) Sectional views f) Detail views g) Isometric views h) Annotations iv) Presentation files a) Assembly placement b) Tweaking components c) Trail location 1. Part files 2. Assembly files 3. Drawing files 4. Presentation files	conventions and the conventions of drafting are still applicable to the view arrangements in CADD. 7. Cartesian and polar coordinates as well as geometric relationships in three dimensional space all use geometric algorithms to define points in space. 8. Each of the four types of files are used to fully describe an objects shape and size. The part file is used for describing individual parts and their geometry within the part file; assembly files describe geometric relationships between parts; drawing files document the geometry of both part and assembly files; presentation files allow the creation of exploded views of assembly files. 9. Solid body creation allows for mating parts to be created in a part file and then be derived to individual parts. 10. Dynamic simulation requires an assembly to allow for the relationship between parts to be analyzed. 11. The stress analysis tool allows for the designer to see a graphic representation of how various geometric variables impact the design.	the parametric software packages 5. Open Inventor and create parts, assemblies, drawings, and presentation files 6. Apply constraints to parts and sketch geometry to achieve desired sketch geometry and part relationships 7. Create an exploded view of an assembly 8. Apply scale and bring views into an Inventor drawing file 9. Use plastic tools to create a part intended for injection molding	*motion from reciprocal to rotational; Geometric tolerances for moving parts; computations related to machining parts to within 0.003"*		Students (NETS) 1 (1,2,3) 2 (1,2,3,4,5) 3 (1,4) 4 (2,4) 5 (3,4) 6 (4) 7 (1,2,5,6) 8 (4,5) 9 (2,5,6) 10 (3,5) HS-ETS1-1 HS-ETS1-2 HS-ETS1-3 HS-ETS1-4	NJSLS N-Q.1-3	1. Marking Period 1 Benchmark TEST 2. Midterm EXAM 3. Student final air engine and/or injection molded part design presentations

Topics/Concepts **(Incl. time / # days per topic)**	**Critical Content** **(Students Will Know:)**	**Skill Objectives** **(Students Will Be Able To:)**	**Instructional/Learning Activities & Interdisciplinary Connections**	**Instructional Resources**	**Technology & 21st C Skills Integration (Specify)**	**NJSLS w/ CPI Reference**	**Evaluation/ Assessment:**
	12. Constraints dictate how part geometry relates to each other, how parts relate to each other in assemblies and how those relationships are documented. 13. The plastic tool palette allows for tools specific to molded parts to be used. 14. Parts can be made in iparts allowing for multiple variables to be assigned to one part file allowing multiple iterations of the same part.	10. Use appropriate views in Inventor drawings to fully describe part and assembly geometry 11. Annotate an Inventor drawing to include dimensions, text, leaders, and bill of materials 12. Create iParts in Inventor by applying spread sheet data to a part file					

Unit Modifications for Special Population Students:

Struggling Learners	Gifted and Talented Students (Challenge Activities)	English Language Learners	Learners with an IEP	Learners with a 504
• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org	• Refer to page four in the Parent and Educator Guide to Section 504 to assist in the development of appropriate plans.

UNIT OVERVIEW

Course Title: Advanced Design Applications in Engineering

Unit #: Unit 4 **Unit Title:** **Structural Systems**

Unit Description and Objectives:
Students interact through learning activities to apply the concepts of structural design to test theories and practices. Emphasis on the correlation between design software simulation and the real behavior of the structural systems is explored.

Essential Questions and Enduring Understandings:

Essential Questions:	**Enduring Understandings/Generalizations Students will understand that:**	**Guiding Questions**
1. What is a safety factor?	1. Safety factors determine how much a structure or an element in a structure must be overbuilt to obtain an acceptable failure point.	1. Should a structure be designed to hold the exact amount of load anticipated?
2. What are static loads?	2. Static loads are loads that exert a constant amount of force,	2. What type of load would the furniture in a house be considered?
3. What are dynamic Loads?	3. Dynamic loads exert varying amounts of force upon the structure that is upholding them.	3. What would be considered the dynamic load on abridge?
4. What is the difference between stress and strain?	4. Strain means relative change in shape or size and implies that it is dimensionless and has no units. Stress, on the other hand, has dimension of force per unit area, or, less often, force per unit length.	4. What is the definition of Young's modulus?
5. What are the five common forces?	5. Compression, tension, shear, torque and bending are the five main forces acting on a structure.	5. What type of forces exist in a cantilever structure?
6. What are the common structural components?	6. The five common structural components are the foundation, wall, floor, header and roof.	6. What is the footing of a structure considered to be a part of?

CURRICULUM UNIT PLAN

Course Title/Grade: Advanced Design Applications in Engineering

Unit Number/Title: **Unit 4- Structural Systems**

Conceptual Lens: Structural systems exist in more than just building and are the foundation of structures of all types.

Appropriate Time Allocation (# of Days)**:** 30

Primary Content Standards referenced With Cumulative Progress Indicators			
8.2.12.A.1	8.2.12.B.2	8.2.12.C.3	8.2.12.E.1
8.2.12.B.1	8.2.12.B.3		
	8.2.12.F.3	8.2.12.D.1	

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
1. Structural Systems 2. Technological Systems 3. Forces on Structures 4. Structural Components 5. Calculating Loads on a Structure.	1. How forces act on a structure. 2. The differences between a shape and a structure. 3. The purpose of planned obsolescence. 4. The differences between durable goods and non-durable goods. 5. The type of external forces. 6. The differences between the	1. Discuss how forces act on a structure. 2. Differentiate between a shape and a structure. 3. Discuss Planned obsolescence. 4. Explain the differences between durable goods and non - durable goods. 5. Compile a list of external forces. 6. Calculate a safety factor. 7. Discuss the difference	Students design and model a cable stayed bride	1. Functioning Intra and Internet 2. Inventor Software 3. Modeling materials as needed 4. Modeling tools 5. Machine tools 6. Hand held power tools	NJSLS 8.1.12.A3,4 8.1.12.D.5 8.1.12.E.1 8.1.12.F.12 9.1.12.A.3 9.1.12.A.6 9.2.12.C.3,6 9.3.12FN-ACT.1-4 CRP1-12 NGSS HS-ETS1-1 HS-ETS1-2 HS-ETS1-3 HS-ETS1-4 Technology Foundation Standards for Students (NETS) 1 (1,2,3) 2 (1,2,3,4,5) 3 (1,4) 4 (2,4) 5 (3,4) 6 (4) 7 (1,2,5,6) 8 (4,5) 9 (2,5,6)	NJSLS: Gr.11-12, RST 1 NJSLS: Gr.11-12, RST 3 NJSLS: Gr.11-12, RST 4 NJSLS: Gr.11-12, RST 8 NJSLS: Gr.11-12, RST 10 NJSLS: Gr.11-12, WHST 6 NJSLS: Gr.11-12, WHST 10 NJSLS N-Q.1-3	**Formative Assessment:** 5. Safety Quiz **Summative Assessment** 4. Marking Period 1 Benchmark TEST 5. Midterm EXAM

Topics/Concepts (Incl. time / # days per topic)	**Critical Content** (Students Will Know:)	**Skill Objectives** (Students Will Be Able To:)	**Instructional/Learning Activities & Interdisciplinary Connections**	**Instructional Resources**	**Technology & 21st C Skills Integration (Specify)**	**NJSLS w/ CPI Reference**	**Evaluation/ Assessment:**
	scientific approach and the technological approach. 7. What equilibrium is. 8. The difference between stress and strain. 9. The five common forces. 10. How to calculate loads.	between the scientific approach and the technological approach to solving a problem. 8. Explain equilibrium. 9. Differentiate between stress and strain. 10. Give examples of the five common forces. 11. Calculate loads on a structural system.			10 (3,5) P21Framework 1. Creativity And Innovation 2. Critical Thinking And Problem Solving 3. Communication And Collaboration 4. Information Literacy 5. Ict (Information, Communications And Technology) Literacy 6. Initiative And Self-Direction 7. Productivity And Accountability ISTE Standards 1. Creativity and innovation 2. Communication and collaboration 3. Research and information fluency 4. Critical thinking, problem solving, and decision making		

Unit Modifications for Special Population Students:

Struggling Learners	Gifted and Talented Students (Challenge Activities)	English Language Learners	Learners with an IEP	Learners with a 504
• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org	• Refer to page four in the Parent and Educator Guide to Section 504 to assist in the development of appropriate plans.

UNIT OVERVIEW

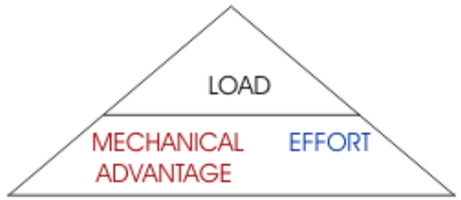
Course Title: Advanced Design Applications in Engineering

Unit #: Unit 5 **Unit Title:** **Mechanical Systems**

Unit Description and Objectives:
This unit exposes students to the theory and design of mechanical systems and mechanisms.

Essential Questions and Enduring Understandings:

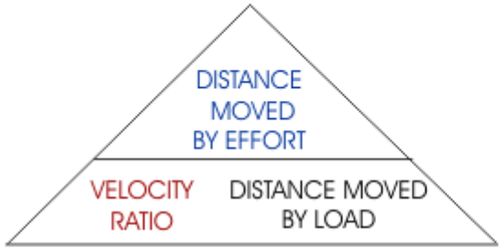
Essential Questions:	**Enduring Understandings/Generalizations Students will understand that:**	**Guiding Questions**
1. How do mechanisms extend human capability to produce a desired output motion or force?	Simple mechanisms multiply man's effort by utilizing velocity ratio. A mechanism takes an input motion or force and returns a desired output motion or force.	How can one person lift more than their weight vertically a distance of 15 feet?
2. What roles have mechanism played in shaping society?	Mechanisms have extended man's physical capabilities allowing him to build the structures and artifacts of contemporary society	How were the pyramids built?
3. What are the six basic machines?	The six basic machines are the lever, wedge, inclined plane, screw, wheel and axle and all mechanisms are made of a combination of the six basic machines.	How are the inclined plane and the screw related?
4. What is mechanical advantage?	Mechanical advantage is load over effort (see below)	What is a gear ratio?
5. What is velocity ratio?	Velocity ratio is related to distance by effort over distance by load (see graphics below)	What is the effort's relationship to the load?



$$\text{MECHANICAL ADVANTAGE} = \frac{\text{LOAD}}{\text{EFFORT}}$$

$$\text{LOAD} = \text{MECHANICAL ADVANTAGE} \times \text{EFFORT}$$

$$\text{EFFORT} = \frac{\text{LOAD}}{\text{MECHANICAL ADVANTAGE}}$$



$$\text{DISTANCE MOVED BY LOAD} = \frac{\text{DISTANCE MOVED BY EFFORT}}{\text{VELOCITY RATIO}}$$

$$\text{VELOCITY RATIO} = \frac{\text{DISTANCE MOVED BY EFFORT}}{\text{DISTANCE MOVED BY LOAD}}$$

$$\text{DISTANCE MOVED BY EFFORT} = \text{DISTANCE MOVED BY LOAD} \times \text{VELOCITY RATIO}$$

CURRICULUM UNIT PLAN

Course Title/Grade: Advanced Design Applications in Engineering

Unit Number/Title: **Unit 5-**

Conceptual Lens: Mechanical Systems

Appropriate Time Allocation (# of Days)**:** 40

Primary Content Standards referenced With Cumulative Progress Indicators			
8.2.12.A.1	8.2.12.B.1	8.2.12.B.2	8.2.12.D.1
8.2.12.E.1	8.2.12.F.1	8.2.12.F.2	8.2.12.F.3

Topics/Concepts (Incl. time / # days per topic)	**Critical Content (Students Will Know:)**	**Skill Objectives (Students Will Be Able To:)**	**Instructional/Learning Activities & Interdisciplinary Connections**	**Instructional Resources**	**Technology & 21st C Skills Integration (Specify)**	**NJSLS w/ CPI Reference**	**Evaluation/ Assessment:**
1. Mechanisms 2. Machines i) Six basic machines (1) Wheel and axle (2) Lever (3) Inclined plane (4) Screw (5) Wedge (6) Pulley 3. Kinematics (1) Linear motion (2) Reciprocal motion (3) Rotary motion (4) Oscillating motion 4. Levers and Linkages 5. Mechanical Advantage 6. Velocity Ratio	1) Describe the difference between mechanisms and machines 2) List the six simple machines. 3) List the six machine elements. 4) Discuss Kinematics. 5) Read and interpret a kinematics diagram. 6) Draw a kinematics diagram. 7) Identify kinematics members. 8) Give examples of linear motion	Build a mechanical device that demonstrates three different motions	1) Student s are given the specifications for an air powered engine and then they build the design. They then improve the design by making it multiple cylinders. *2) Interdisciplinary Connections:* *3) Physics laws of motion* 4) *Math geometry, measurement to 0.001" as well as to 0.025mm*	1) Inventor software 2) Functioning Inter and Intranet 3) Milling machine 4) Lathe 5) Digital Read Outs on lathe and Mill 6) Aluminum 7) Steel 8) Compressor 9) Air fittings to allow connection to air engine and run the coolant misters in the machine shop	NJSLS 8.1.12.A3,4 8.1.12.D.5 8.1.12.E.1 8.1.12.F.12 9.1.12.A.3 9.1.12.A.6 9.2.12.C.3,6 9.3.12FN-ACT.1-4 CRP1-12 NGSS HS-ETS1-1 HS-ETS1-2 HS-ETS1-3 HS-ETS1-4 Technology Foundation Standards for Students (NETS) 1 (1,2,3) 2 (1,2,3,4,5) 3 (1,4) 4 (2,4) 5 (3,4) 6 (4) 7 (1,2,5,6) 8 (4,5) 9 (2,5,6) 10 (3,5) 4 (2,4)	NJSLS: Gr.11-12, RST 1 NJSLS: Gr.11-12, RST 3 NJSLS: Gr.11-12, RST 4 NJSLS: Gr.11-12, RST 8 NJSLS: Gr.11-12, RST 10 NJSLS: Gr.11-12, WHST 6 NJSLS: Gr.11-12, WHST 10 NJSLS N-Q.1-3	**Formative Assessment:** 6. Safety Quiz 7. Machine skills practical tests **Summative Assessment** 6. Students turn in solid model of air engine with associated engineering documentation that includes: i) Multiviews of the assembly ii) Inventor part and assembly files

Topics/Concepts (Incl. time / # days per topic)	**Critical Content (Students Will Know:)**	**Skill Objectives (Students Will Be Able To:)**	**Instructional/Learning Activities & Interdisciplinary Connections**	**Instructional Resources**	**Technology & 21st C Skills Integration (Specify)**	**NJSLS w/ CPI Reference**	**Evaluation/ Assessment:**
	9) Give examples of reciprocal motion Give examples of rotary motion Give examples of oscillating motion				5 (3,4) 6 (4) 7 (1,2,5,6) 8 (4,5) 9 (2,5,6) 10 (3,5) **P21Framework** 1. Creativity And Innovation 2. Critical Thinking And Problem Solving 3. Communication And Collaboration 4. Information Literacy 5. Ict (Information, Communications And Technology) Literacy 6. Initiative And Self-Direction 7. Productivity And Accountability **ISTE Standards** 1. Creativity and innovation 2. Communication and collaboration 3. Research and information fluency 4. Critical thinking, problem solving, and decision making		iii) Inventor presentation file iv) Bill of materials v) All necessary annotations including dimensions 7. Midterm EXAM

Unit Modifications for Special Population Students:

Struggling Learners	Gifted and Talented Students (Challenge Activities)	English Language Learners	Learners with an IEP	Learners with a 504
• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org	• Refer to page four in the Parent and Educator Guide to Section 504 to assist in the development of appropriate plans.

UNIT OVERVIEW

Course Title: Advanced Design Applications in Engineering

Unit #: Unit 6 **Unit Title:** **Electronic Systems**

Unit Description and Objectives:
This unit introduces the students to mechanisms, kinematics, simple machines, load, effort and mechanical advantage. The students engage in a variety of activities that place them in the role of designer/engineer while attempting to solve problems centered on mechanical systems.

Essential Questions and Enduring Understandings:

Essential Questions:	**Enduring Understandings/Generalizations Students will understand that:**	**Guiding Questions**
1. How do electronic circuits aid in our everyday lives?	1. Virtually everything we contact during our daily lives has an electronic component associated with it.	Can you name one item in your daily life that has no relationship to electronics or electricity?
2. What makes up a control circuit?	2.Control circuits are comprised of input, process and output	What are the input, process and output of pressing a computer keyboard's "A" key?
3. What is the function of an input?	3. The function of an input is to provide data and control signals to an information processing system like a computer.	What is the input(s) of a natural gas oven?
4. What goes on in the process phase?	4. The processor evaluates inputs and performs outputs based on a set of logical instructions.	What is evaluated when a thermostat is set to a specific temperature?
5. What is the function of an output?	5. The output's function is to control a physical process or perform some type of mathematical operation on the signal.	What is the output of an O2 sensor on an automobile?

CURRICULUM UNIT PLAN

Course Title/Grade: Advanced Design Applications in Engineering

Unit Number/Title: **Unit 6-** Electronic Systems

Conceptual Lens:

Appropriate Time Allocation (# of Days)**:** 20

Primary Content Standards referenced With Cumulative Progress Indicators			
8.2.12.A.1	8.2.12.C.3	8.2.12.B.3	
8.2.12.D.1 .	8.2.12.F.1		
8.2.12.E	8.2.12.C.3		

Topics/Concepts (Incl. time / # days per topic)	**Critical Content** (Students Will Know:)	**Skill Objectives** (Students Will Be Able To:)	**Instructional/Learning Activities & Interdisciplinary Connections**	**Instructional Resources**	**Technology & 21st C Skills Integration (Specify)**	**NJSLS w/ CPI Reference**	**Evaluation/ Assessment:**
1. Inputs a. Sensors b. Switches 2. Process a. Signal b. Conditioning c. Logic 3. Outputs a. Displays b. Actuators 4. Electricity a. Voltage b. Amperage c. Resistance 5. Ohms Law 6. Alternating Current 7. Direct Current	The differences between inputs, outputs, and processes. The functions of sensors The functions of transducers, actuators, and displays. The differences between	Explain the difference between inputs, outputs, and processes. Apply various sensors to accomplish a task. Apply various output devices to accomplish a task.	1. Students utilize Arduino, parallax basic stamp or other available microcontroller to develop a circuit that demonstrates input, process and output by having an LED light, blink and stay on and off for specified periods of time. 2. Students build on knowledge from above activity to develop a program to control multiple devices that perform a task such as automatically having a solar panel track the sun for optimal photovoltaic production.	1. Functioning intra and internet 2. Microcontroller such as an Arduino 3. Assorted electronic components such as resistors, LED's, wire, etc. 4. Multimeters 5. Solder iron and solder 6. Appropriate connections to microprocessor from PC	NJSLS 8.1.12.A3,4 8.1.12.D.5 8.1.12.E.1 8.1.12.F.12 9.1.12.A.3 9.1.12.A.6 9.2.12.C.3,6 9.3.12FN-ACT.1-4 CRP1-12 NGSS HS-ETS1-1 HS-ETS1-2 HS-ETS1-3 HS-ETS1-4 1. P21Framework 2. Creativity And Innovation 3. Critical Thinking And Problem Solving 4. Communication And Collaboration 5. Information Literacy	8.2.12.A.1 8.2.12.B.3 8.2.12.C.3 8.2.12.D.1 8.2.12.E.1 8.2.12.F.1 NJSLS.ELA-LITERACY.RST.11-12.1 NJSLS.ELA-LITERACY.RST.11-12.2 NJSLS.ELA-LITERACY.RST.11-12.3 NJSLS.ELA-LITERACY.RST.11-12.4 NJSLS.ELA-LITERACY.RST.11-12.5 NJSLS.MATH.CONTENT.HSF.TF.B.7 NJSLS.MATH.CONTENT.HSG.GMD.B.4 NJSLS: Gr.11-12, RST 1 NJSLS: Gr.11-12, RST 3 NJSLS: Gr.11-12, RST 4 NJSLS: Gr.11-12, RST 8 NJSLS: Gr.11-12, RST 10 NJSLS: Gr.11-12, WHST 6 NJSLS: Gr.11-12, WHST 10 NJSLS N-Q	**Formative Assessment:** 1. Students give weekly progress presentations for peer review and teacher guidance **Summative Assessment** 1. Students demonstrate functionality of device to have it include: Printout of program

Topics/Concepts (Incl. time / # days per topic)	**Critical Content (Students Will Know:)**	**Skill Objectives (Students Will Be Able To:)**	**Instructional/Learning Activities & Interdisciplinary Connections**	**Instructional Resources**	**Technology & 21st C Skills Integration (Specify)**	**NJSLS w/ CPI Reference**	**Evaluation/ Assessment:**
	alternating current and direct current. The purposes of insulators and conductors in a circuit. The relationship of voltage, current, and resistance in a circuit. How to calculate circuit values using ohms law.	Solve a simple problem by applying an electronic circuit. Build simple AC and Dc circuits on a breadboard. Calculate circuit values. Measure circuit values			6. Ict (Information, Communications And Technology) Literacy 7. Initiative And Self-Direction 8. Productivity And Accountability 9. ISTE Standards 10. Creativity and innovation 11. Communication and collaboration 12. Research and information fluency 13. Critical thinking, problem solving, and decision making 14. 15. Technology Foundation Standards for Students (NETS) 16. 1 (1,2,3) 17. 2 (1,2,3,4,5) 18. 3 (1,4) 19. 4 (2,4) 20. 5 (3,4) 21. 6 (4) 22. 7 (1,2,5,6) 23. 8 (4,5) 24. 9 (2,5,6) 10 (3,5)		Electronic schematic of components and their function Running the code to have their design perform specified tasks as needed.

Unit Modifications for Special Population Students:

Struggling Learners	Gifted and Talented Students (Challenge Activities)	English Language Learners	Learners with an IEP	Learners with a 504
• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org	• Refer to page four in the Parent and Educator Guide to Section 504 to assist in the development of appropriate plans.

UNIT OVERVIEW

Course Title: Advanced Design Applications in Engineering

Unit #: Unit 7 **Unit Title:** **Fluid Systems**

Unit Description and Objectives:
This unit's focus is centered on the use of fluid systems and their application in a variety of scenarios. The distinction between pneumatic and hydraulic applications are emphasized along with some of the basic laws that govern the design factors for these systems.

Essential Questions and Enduring Understandings:

Essential Questions:	**Enduring Understandings/Generalizations Students will understand that:**	**Guiding Questions**
1. What is a pneumatic system?	1. Pneumatic refers to the use of compressed air.	What examples of a pneumatic system do we have in the lab?
2. What is a hydraulic system?	2. Hydraulic refers to the use of a liquid.	What examples of a hydraulic system can be found in an automobile?
3. What is compressibility?	3. Compressibility is a measure of the relative volume change of a fluid or solid as a response to a pressure (or mean stress) change.	Can hydraulics be compressed?
4. What are the components of each system?	4. Reservoir, pump, control valve and actuator are hydraulic system components while pneumatic systems contain compressor, tank or reservoir for holding compressed gas, and cylinders for actuation	What do a hydraulic and pneumatic have in common?
5. What are the advantages and disadvantages of each system?	5. Gas absorbs excessive force, whereas fluid in hydraulics directly transfers force	Why would one select a hydraulic system over a pneumatic system?
6. What is fluidic logic?	6. Fluidics, or fluidic logic, is the use of a fluid to perform analog or digital operations similar to those performed with electronics.	How does fluidics differ from pneumatic systems?

CURRICULUM UNIT PLAN

Course Title/Grade: Advanced Design Applications in Engineering

Unit Number/Title: Unit 7- **Fluid Systems**

Conceptual Lens: Fluid systems are used in a variety of applications and many times are joined with other systems such as mechanical to accomplish a task.

Appropriate Time Allocation (# of Days): 20

Primary Content Standards referenced With Cumulative Progress Indicators

8.2.12.A.1	8.2.12.C.3	8.2.12.B.31	8.2.12.A.1
8.2.12.D.1	8.2.12.B.3		8.2.12.C.3
8.2.12.F.1	8.2.12.E	8.2.12.B.3	8.2.12.D.1

Topics/Concepts (Incl. time / # days per topic)	**Critical Content (Students Will Know:)**	**Skill Objectives (Students Will Be Able To:)**	**Instructional/Learning Activities & Interdisciplinary Connections**	**Instructional Resources**	**Technology & 21st C Skills Integration (Specify)**	**NJSLS w/ CPI Reference**	**Evaluation/ Assessment:**
1) Principals of Pneumatics 2) Bernoulli's law 3) Boyle's law 4) Principals of Hydraulics 5) Fluidic principles 6) Pascal's law 7) Characteristics of fluids 8) Pascal's Law 9) Compressed Air 10) System Components i) Cylinders ii) Valves iii) Regulators iv) Flow Controls v) Solenoids	1) What a pneumatic system is. 2) What a hydraulic system is. 3) What the similarities are in pneumatic and hydraulic systems. 4) What the differences are between	1) Design and fabricate a basic pneumatic system to perform a basic task such as lifting a 10 lb. weight a specified distance above the ground 2) Design and fabricate a basic hydraulic	1. Using pneumatic, hydraulics and the concept of fluidics students develop a solution to a selected design problem. In this unit students are guided in the selection of a design problem. Students are broken into groups with each group member tasked with	1. Functioning intra and internet 2. Compressor 3. Hydraulic pump 4. Air hoses 5. Hydraulic hoses 6. Tools and machines of H110 and H111 7. Assorted materials such as steel, aluminum, wood and modeling materials	NJSLS 8.1.12.A3,4 8.1.12.D.5 8.1.12.E.1 8.1.12.F.12 9.1.12.A.3 9.1.12.A.6 9.2.12.C.3,6 9.3.12FN-ACT.1-4 CRP1-12 NGSS HS-ETS1-1 HS-ETS1-2 HS-ETS1-3 HS-ETS1-4 1. P21Framework 2. Creativity And Innovation 3. Critical Thinking And Problem Solving 4. Communication And Collaboration 5. Information Literacy	8.2.12.A.1 8.2.12.B.3 8.2.12.C.3 8.2.12.D.1 8.2.12.E.1 8.2.12.F.1 NJSLS.ELA-LITERACY.RST.11-12.1 NJSLS.ELA-LITERACY.RST.11-12.2 NJSLS.ELA-LITERACY.RST.11-12.3 NJSLS.ELA-LITERACY.RST.11-12.4 NJSLS.ELA-LITERACY.RST.11-12.5 NJSLS.MATH.CONTENT.HSF.TF.B.7 NJSLS.MATH.CONTENT.HSG.GMD.B.4 NJSLS: Gr.11-12, RST 1 NJSLS: Gr.11-12, RST 3 NJSLS: Gr.11-12, RST 4 NJSLS: Gr.11-12, RST 8 NJSLS: Gr.11-12, RST 10 NJSLS: Gr.11-12, WHST 6 NJSLS: Gr.11-12, WHST 10 NJSLS N-Q	**Formative Assessment:** 1. Students give weekly progress presentations for peer review and teacher guidance **Summative Assessment** i) Students demonstrate solid model or simulation and identify: ii) Bernoulli's law i) Pascal's law ii) Boyle's law

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
	pneumatic and hydraulic systems. 5) Pascal's Law 6) Bernoulli's law 7) Boyle's law 8) There are different types of compressors. 9) There are different types of control valves.	system to perform a basic task such as lifting a 10 lb. weight a specified distance above the ground 3) State Bernoulli's law and its relationship to fluidics 4) State Pascal's law and its relationship to hydraulic systems 5) State Boyle's law and its relationship pneumatics	the responsibility of either pneumatic, hydraulic or fluidic system design with the aim of having each sub system join into one system to accomplish the pre-defined task. 2. Students take previously designed air engine and modify it for hydraulic actuation.		6. Ict (Information, Communications And Technology) Literacy 7. Initiative And Self-Direction 8. Productivity And Accountability 9. ISTE Standards 10. Creativity and innovation 11. Communication and collaboration 12. Research and information fluency 13. Critical thinking, problem solving, and decision making Technology Foundation Standards for Students (NETS) 14. 1 (1,2,3) 15. 2 (1,2,3,4,5) 16. 3 (1,4) 17. 4 (2,4) 18. 5 (3,4) 19. 6 (4) 20. 7 (1,2,5,6) 21. 8 (4,5) 22. 9 (2,5,6) 10 (3,5)		2. Students demonstrate design's ability to perform a task using hydraulic and pneumatic systems.

Unit Modifications for Special Population Students:

Struggling Learners	Gifted and Talented Students (Challenge Activities)	English Language Learners	Learners with an IEP	Learners with a 504
• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org	• Refer to page four in the Parent and Educator Guide to Section 504 to assist in the development of appropriate plans.

UNIT OVERVIEW

Course Title: Advanced Design Applications in Engineering

Unit #: Unit 8 **Unit Title:** **Materials, Testing and, Prototyping**

Unit Description and Objectives:
Please describe this unit and the students' learning outcomes.

Essential Questions and Enduring Understandings:

Essential Questions:	**Enduring Understandings/Generalizations Students will understand that:**	**Guiding Questions**
1. What roles have different materials played in the development of technology?	1. Materials are necessary to produce models of design solutions.	1. What material developments were necessary for the development of space travel?
2. How have certain technologies been held back because of the lack of proper materials?	2. Appropriate Materials and production processes are an essential part of technological design.	2. What materials were the limiting factor in computing capacity?
3. What are the eleven material properties?	1 Acoustical properties 2 Atomic properties 3 Chemical properties 4 Electrical properties 5 Environmental properties 6 Magnetic properties 7 Manufacturing properties 8 Mechanical properties 9 Optical properties 10 Radiological properties 11 Thermal properties	3. What material properties would be important to consider when designing a CAT scan machine? An automobile windshield? A test tube for medical research?
4. What are the material classifications?	3. The material classifications are metal, ceramic, polymer and composite	4. How would you classify an artificial hip joint in terms of its material classification?

5. What are the different types of models	5. There are functional models; mass models; appearance models and prototypes	5. What type of model would an engineer use to present a concept to a potential client?
6. How does the designer know if his design is successful?	6. The design must be tested or evaluated to see if it meets the design criteria.	6. What determines a design's success?
7. Where do test criteria come from?	7. Engineers many times are generating the criteria by which the success of a design is measured	7. How would you know if your design was successful?
8. What techniques should be used to present the results?	8. Developing appropriate tests is another application of the design process.	8. How should the results of testing be formatted for non-technical personnel?
9. What happens if the design does not meet all of the criteria?	9. Seldom does a design meet all of the criteria.	9. Are all design criteria equal in importance?
10. What happens if the design meets little or none of the criteria?	10. Identification of the problem occurs followed by successive iterations of the design loop	10. At what point is a design considered a failure?
11. How do you determine critical criteria?	11. The design must be tested or evaluated to see if it meets the design criteria.	11. Should all criteria have the same importance?

CURRICULUM UNIT PLAN

Course Title/Grade: Advanced Design Applications in Engineering

Unit Number/Title: **Unit 8- Materials, Testing and, Prototyping**

Conceptual Lens: Material selection is just as crucial for the design of a product as it is for creating a model of the solution. Material properties influence the finished products as well as the processes used to create them.

Appropriate Time Allocation (# of Days)**:** 20

Primary Content Standards referenced With Cumulative Progress Indicators			
8.2.12.A.1	8.2.12.C.3	8.2.12.B.31	
8.2.12.B.3 .			
		8.2.12.F.1	
8.2.12.E			
	8.2.12.D.1	8.2.12.C.3	

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
1) Material Selection 2) Physical Properties 3) Material Classification 4) Types of Paper Products 5) Metals 6) Ferrous 7) Nonferrous 8) Ceramics 9) Polymers 10) Composites 11) Wood 12) Adhesives 13) Coatings 14) Graphics 15) Developing Appropriate Tests 16) Testing the Design	1) The importance of materials and their impact on history. 2) The factors involved in material selection. 3) The nine properties of material. 4) Eleven material classifications 5) The effects of proper fit and finish on a model 6) The importance of Testing and evaluation.	1) Identify five consumer products and make a list of all the materials used to produce those products. 2) Develop a materials matrix listing a materials characteristics and give probable justifications for its selection. 3) List three examples of a particular product	1. Students are given a product to reverse engineer, identify the materials used to construct the product, model the product with changes they made to improve some aspect of it, and list the new materials and their properties. 2. Students take an existing design they completed and evaluate the material selection and determine the type of testing that should be	1) Functioning intra and internet 2) Inventor software 3) Tools and equipment of H110 and H111 4) Aluminum, steel, wood, modeling materials such as balsa wood and foam core	NJSLS 8.1.12.A3,4 8.1.12.D.5 8.1.12.E.1 8.1.12.F.12 9.1.12.A.3 9.1.12.A.6 9.2.12.C.3,6 9.3.12FN-ACT.1-4 CRP1-12 NGSS HS-ETS1-1 HS-ETS1-2 HS-ETS1-3 HS-ETS1-4 1. P21Framework 2. Creativity And Innovation 3. Critical Thinking And Problem Solving 4. Communication And Collaboration	8.2.12.A.1 8.2.12.B.3 8.2.12.C.3 8.2.12.D.1 8.2.12.E.1 8.2.12.F.1 NJSLS.ELA-LITERACY.RST.11-12.1 NJSLS.ELA-LITERACY.RST.11-12.2 NJSLS.ELA-LITERACY.RST.11-12.3 NJSLS.ELA-LITERACY.RST.11-12.4 NJSLS.ELA-LITERACY.RST.11-12.5 NJSLS.MATH.CONTENT.HSF.TF.B.7 NJSLS.MATH.CONTENT.HSG.GMD.B.4 NJSLS: Gr.11-12, RST 1 NJSLS: Gr.11-12, RST 3 NJSLS: Gr.11-12, RST 4 NJSLS: Gr.11-12, RST 8 NJSLS: Gr.11-12, RST 10 NJSLS: Gr.11-12, WHST 6 NJSLS: Gr.11-12, WHST 10 NJSLS N-Q.1-3	**Formative Assessment:** 1. Students give weekly progress presentations for peer review and teacher guidance **Summative Assessment** 2. Students present detailed material analysis of their designs listing material types, material characteristics and their suitability for

Topics/Concepts (Incl. time / # days per topic)	**Critical Content (Students Will Know:)**	**Skill Objectives (Students Will Be Able To:)**	**Instructional/Learning Activities & Interdisciplinary Connections**	**Instructional Resources**	**Technology & 21st C Skills Integration (Specify)**	**NJSLS w/ CPI Reference**	**Evaluation/ Assessment:**
17) Presenting the Results 18) Evaluating Project Results 19) Evaluating Design Skills	7) How to develop appropriate tests for a design project. 8) How to measure characteristics. 9) 10) The value of presenting test results. 11) Various presentation methods.	made from at least three different materials. 4) Develop an appearance model for a product they have designed 5) Develop a prototype model for a product they have designed.	used in order to prove their design's manufacturability.		5. Information Literacy 6. Ict (Information, Communications And Technology) Literacy 7. Initiative And Self-Direction 8. Productivity And Accountability 9. ISTE Standards 10. Creativity and innovation 11. Communication and collaboration 12. Research and information fluency 13. Critical thinking, problem solving, and decision making 14. 15. Technology Foundation Standards for Students (NETS) 16. 1 (1,2,3) 17. 2 (1,2,3,4,5) 18. 3 (1,4) 19. 4 (2,4)		use in their design.

Topics/Concepts (Incl. time / # days per topic)	**Critical Content** (Students Will Know:)	**Skill Objectives** (Students Will Be Able To:)	**Instructional/Learning Activities & Interdisciplinary Connections**	**Instructional Resources**	**Technology & 21st C Skills Integration (Specify)**	**NJSLS w/ CPI Reference**	**Evaluation/ Assessment:**
					20. 5 (3,4) 21. 6 (4) 22. 7 (1,2,5,6) 23. 8 (4,5) 24. 9 (2,5,6) 25. 10 (3,5)		

Unit Modifications for Special Population Students:

Struggling Learners	Gifted and Talented Students (Challenge Activities)	English Language Learners	Learners with an IEP	Learners with a 504
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			learning opportunities. The framework can be viewed here www.udlguidelines.cast.org	

CROSS-CONTENT STANDARDS ANALYSIS

Course Title: Advanced Design Applications in Engineering **Grade:** 11-12

Unit Title:	Visual and Performing Arts	Comp. Health & Physical Ed.	English Language Arts	Mathematics	Science	Social Studies	World Languages	Technology	21st Century Life & Careers
I. The World of Engineering			NJSLS: Gr.11-12, RST 1 NJSLS: Gr.11-12, RST 3 NJSLS: Gr.11-12, RST 4 NJSLS: Gr.11-12, RST 8 NJSLS: Gr.11-12, RST 10 NJSLS: Gr.11-12, WHST 6 NJSLS: Gr.11-12, WHST 10	NJSLS N-Q.1-3				8.1.12.A3,4 8.1.12.D.5 8.1.12.E.1 8.1.12.F.12 8.2.12.B.4 8.2.12.C.5 9.1.12.A.3 9.1.12.A.6 9.2.12.C.3,6 9.3.12FN-ACT.1-4 CRP1-12 9.3.12.AC.4 9.3.12.AC.5 9.3.12.AC.7	
II. Safety and Coursework in the Engineering lab			NJSLS: Gr.11-12, RST 1 NJSLS: Gr.11-12, RST 3 NJSLS: Gr.11-12, RST 4 NJSLS: Gr.11-12, RST 8 NJSLS: Gr.11-12, RST 10 NJSLS: Gr.11-12, WHST 6 NJSLS: Gr.11-12, WHST 10	NJSLS N-Q.1-3				8.1.12.A3,4 8.1.12.D.5 8.1.12.E.1 8.1.12.F.12 9.1.12.A.3 9.1.12.A.6 9.2.12.C.3,6 9.3.12FN-ACT.1-4 CRP1-12	

III. Engineering Design Fundamentals			NJSLS: Gr.11-12, RST 1 NJSLS: Gr.11-12, RST 3 NJSLS: Gr.11-12, RST 4 NJSLS: Gr.11-12, RST 8 NJSLS: Gr.11-12, RST 10 NJSLS: Gr.11-12, WHST 6 NJSLS: Gr.11-12, WHST 10	NJSLS N-Q.1-3	HS-ETS1-1 HS-ETS1-2 HS-ETS1-3 HS-ETS1-4			8.1.12.A3,4 8.1.12.D.5 8.1.12.E.1 8.1.12.F.12 9.1.12.A.3 9.1.12.A.6 9.2.12.C.3,6 9.3.12FN-ACT.1-4 CRP1-12	
IV. Structural Systems			NJSLS: Gr.11-12, RST 1 NJSLS: Gr.11-12, RST 3 NJSLS: Gr.11-12, RST 4 NJSLS: Gr.11-12, RST 8 NJSLS: Gr.11-12, RST 10 NJSLS: Gr.11-12, WHST 1.a NJSLS: Gr.11-12, WHST 1.c NJSLS: Gr.11-12, WHST 6 NJSLS: Gr.11-12, WHST 10	NJSLS N-Q.1-3	HS-ETS1-1 HS-ETS1-2 HS-ETS1-3 HS-ETS1-4			8.1.12.A3,4 8.1.12.D.5 8.1.12.E.1 8.1.12.F.12 9.1.12.A.3 9.1.12.A.6 9.2.12.C.3,6 9.3.12FN-ACT.1-4 CRP1-12	P21Framework 1. Creativity And Innovation 2. Critical Thinking And Problem Solving 3. Communication And Collaboration 4. Information Literacy 5. Ict (Information, Communications And Technology) Literacy 6. Initiative And Self-Direction 7. Productivity And Accountability 8. ISTE Standards 9. Creativity and innovation 10. Communication and collaboration 11. Research and information fluency 12. Critical thinking, problem solving, and decision making
V. Mechanical Systems			NJSLS: Gr.11-12, RST 1 NJSLS: Gr.11-12, RST 3 NJSLS: Gr.11-12, RST 4 NJSLS: Gr.11-12, RST 8 NJSLS: Gr.11-12, RST 10 NJSLS: Gr.11-12, WHST 6 NJSLS: Gr.11-12, WHST 10	NJSLS N-Q.1-3	HS-ETS1-1 HS-ETS1-2 HS-ETS1-3 HS-ETS1-4			8.1.12.A3,4 8.1.12.D.5 8.1.12.E.1 8.1.12.F.12 9.1.12.A.3 9.1.12.A.6 9.2.12.C.3,6	P21Framework 1. Creativity And Innovation 2. Critical Thinking And Problem Solving 3. Communication And Collaboration

								9.3.12FN-ACT.1-4 CRP1-12	4. Information Literacy 5. Ict (Information, Communications And Technology) Literacy 6. Initiative And Self-Direction 7. Productivity And Accountability 8. ISTE Standards 9. Creativity and innovation 10. Communication and collaboration 11. Research and information fluency 12. Critical thinking, problem solving, and decision making
VI. Electronic Systems			NJSLS: Gr.11-12, RST 1 NJSLS: Gr.11-12, RST 3 NJSLS: Gr.11-12, RST 4 NJSLS: Gr.11-12, RST 8 NJSLS: Gr.11-12, RST 10 NJSLS: Gr.11-12, WHST 1.a NJSLS: Gr.11-12, WHST 1.c NJSLS: Gr.11-12, WHST 6 NJSLS: Gr.11-12, WHST 10	NJSLS N-Q.1-3	HS-ETS1-1 HS-ETS1-2 HS-ETS1-3 HS-ETS1-4			8.1.12.A3,4 8.1.12.D.5 8.1.12.E.1 8.1.12.F.12 9.1.12.A.3 9.1.12.A.6 9.2.12.C.3,6 9.3.12FN-ACT.1-4 CRP1-12	P21Framework 1. Creativity And Innovation 2. Critical Thinking And Problem Solving 3. Communication And Collaboration 4. Information Literacy 5. Ict (Information, Communications And Technology) Literacy 6. Initiative And Self-Direction 7. Productivity And Accountability 8. ISTE Standards 9. Creativity and innovation 10. Communication and collaboration 11. Research and information fluency 12. Critical thinking, problem solving,

									and decision making
VII. Pneumatic Systems			NJSLS: Gr.11-12, RST 1 NJSLS: Gr.11-12, RST 3 NJSLS: Gr.11-12, RST 4 NJSLS: Gr.11-12, RST 8 NJSLS: Gr.11-12, RST 10 NJSLS: Gr.11-12, WHST 6 NJSLS: Gr.11-12, WHST 10	NJSLS N-Q.1-3	HS-ETS1-1 HS-ETS1-2 HS-ETS1-3 HS-ETS1-4			8.1.12.A3,4 8.1.12.D.5 8.1.12.E.1 8.1.12.F.12 9.1.12.A.3 9.1.12.A.6 9.2.12.C.3,6 9.3.12FN-ACT.1-4 CRP1-12	P21Framework 1. Creativity And Innovation 2. Critical Thinking And Problem Solving 3. Communication And Collaboration 4. Information Literacy 5. Ict (Information, Communications And Technology) Literacy 6. Initiative And Self-Direction 7. Productivity And Accountability 8. ISTE Standards 9. Creativity and innovation 10. Communication and collaboration 11. Research and information fluency 12. Critical thinking, problem solving, and decision making
VIII. Materials, Testing and, Prototyping			NJSLS: Gr.11-12, RST 1 NJSLS: Gr.11-12, RST 3 NJSLS: Gr.11-12, RST 4 NJSLS: Gr.11-12, RST 8 NJSLS: Gr.11-12, RST 10 NJSLS: Gr.11-12, WHST 6 NJSLS: Gr.11-12, WHST 10	NJSLS N-Q.1-3	HS-ETS1-1 HS-ETS1-2 HS-ETS1-3 HS-ETS1-4			8.1.12.A3,4 8.1.12.D.5 8.1.12.E.1 8.1.12.F.12 9.1.12.A.3 9.1.12.A.6 9.2.12.C.3,6 9.3.12FN-ACT.1-4 CRP1-12	P21Framework 1. Creativity And Innovation 2. Critical Thinking And Problem Solving 3. Communication And Collaboration 4. Information Literacy 5. Ict (Information, Communications And Technology) Literacy 6. Initiative And Self-Direction

									7. Productivity And Accountability 8. ISTE Standards 9. Creativity and innovation 10. Communication and collaboration 11. Research and information fluency 12. Critical thinking, problem solving, and decision making

***All content areas may not be applicable in a particular course.**

Washington Township Public Schools
Department of Student Personnel Services

CURRICULUM MODIFICATION

The regular curriculum is modified for Special Education students enrolled in both self-contained and resource center classes.

Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include:

- Variation of time: adapting the time allotted for learning, task completion, or testing
- Variation of input: adapting the way instruction is delivered
- Variation of output: adapting how a student can respond to instruction
- Variation of size: adapting the number of items the student is expected to complete
- Modifying the content, process or product

Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here.

Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org