3/5/2013

El Monte Union High School District

Course Outline

High School District

Title: AE, Aerospace Engineering (PLTW)

Transitional*_____(Eng. Dept. Only)

Sheltered (SDAIE)*____Bilingual*___

AP**_____Honors**_____

Department: Math/Science/Industrial

Grade Level (s):_____10-12_____

Semester_____Year__X_____

Year of State Framework Adoption_____

This course meets graduation requirements:

( ) English
( ) Fine Arts
( ) Foreign Language
( ) Health & Safety
( ) Math
( ) Physical Education
( ) Science
( ) Social Science
(X) Elective

Department/Cluster Approval	Date
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

*Instructional materials appropriate for English Language Learners are required.

**For AP/Honors course attach a page describing how this course is above and beyond a regular course. Also, explain why this course is the equivalent of a college level class.

1.Prerequisite(s):
Aerospace Engineering is a high school level course that is appropriate for 10th, 11th, or 12th grade students interested in Aerospace. It is recommended that students are concurrently enrolled in college preparatory mathematics and science courses and have successfully completed the Principles of Engineering (POE) course.

2. Short description of course which may also be used in the registration manual:
Aerospace Engineering (AE) is the study of the engineering discipline which develops new technologies for use in aviation, defense systems, and space exploration. The course explores the evolution of flight, flight fundamentals, navigation and control, aerospace materials, propulsion, space travel, orbital mechanics, ergonomics, remotely operated systems and related careers. In addition the course presents alternative applications for aerospace engineering concepts. This course is designed for 10th, 11th, & 12th grade students.

3. Describe how this course integrates the schools ESLRs (Expected School-wide Learning Results):
Utilizing the activity-project-problem-based (APPB) teaching and learning pedagogy, students will analyze, design, and build aerospace systems. While implementing these designs, students will continually hone their interpersonal skills, creativity, and application of the design process. Students apply knowledge gained throughout the course in a final multi-media project to envision their future professional accomplishments.

4. **Describe the additional efforts/teaching techniques/methodology to be used to meet the needs of English Language Learners:**

This course integrates South El Monte High School's ESLRs by combining elements of hands on career technical education in various areas of material working with the fundamental skills of reading, writing and mathematics. Furthermore, concepts from the physical sciences will be used during on-going instruction to facilitate student observation and learning of fundamental common practices in product design, engineering problem solving and production processes. A high degree of computer-based programming technology will be used. Assessment methods will be based on project evaluations specifically involving a measurement of the degree to which students follow written instructions in the execution of the operations involved in designing and constructing projects. Additionally, student designs (blueprints) will be assessed based on how well they conform to a grading rubric based on industry standards. Project or activity-based assessments will also be utilized to grade students

5. Describe the interdepartmental articulation process for this course:

Students who successfully complete the introductory portion of this course will have laid a firm foundation in the most fundamental skills used in all areas of design, engineering and production. The skills that will be used are: measurement, estimating, testing, design evaluation, prototyping, one-off production, programming, re-engineering, reverse engineering, repair, design improvement, computer-aided design, computer-aided manufacturing, production planning, manufacturing engineering process design, shop management, inventory management, materials management, workplace management and workforce management.

There are math worksheets that contain math relevant questions containing academic language relevant to aerospace engineering and other Engineering and Science classes. These will be collaborated at different parts of the year with the math department. In addition, reports will be written and in industry standard formats containing relevant academic language. Collaboration will take place between the Engineering department and English department to discuss the timing and rubrics of such assignments. Student will also build from the computer/technical skills they attain from the business tech core department, thus collaboration will occur to transition students from basic skills to the more advance skills required in the field of engineering.

6. **Describe how this course will integrate academic and vocational concepts, possibly through connecting activities. Describe how this course will address work-based learning/school to career concepts:**

Engineering is one of the fastest growing, highest paying professions in California. This course prepares students for engineering fields and gives them a head start over other students majoring in college in the same field. The class has real world applications of dynamics of flight, design, and aerospace engineering allow students to design miniature manufacturing processes. The Aerospace Engineering class is project centered and computer based and gives students the skills they need to succeed in college and their future careers.

7. Materials of Instruction (Note: Materials of instruction for English Language Learners are required and should be listed below.)

A. Textbook(s) and Core Reading(s):

As required by the PLTW materials guide (32 page material guide is updated yearly)

B. Supplemental Materials and Resources:

As required by the PLTW materials guide (32 page material guide is updated yearly)

C. Tools, Equipment, Technology, Manipulatives, Audio-Visual:

As required by the PLTW materials guide (32 page material guide is updated yearly)

8.

- **Objectives of Course**
- **Unit detail including projects and activities including duration of units (pacing plan)**
- **Indicate references to state framework(s)/standards (If state standard is not applicable then national standard should be used)**
- **Student performance standards**
- **Evaluation/assessment/rubrics**
- **Include minimal attainment for student to pass course**

Aerospace Engineering Detailed Outline

Unit 1: Introduction to Aerospace

Time Days: 48 days

Lesson 1.1: Evolution of Flight (8 days)

Concepts Addressed in Lesson

1. Understanding the evolution of flight instills an appreciation of past engineering accomplishments.

2. Knowledge of aerospace history provides insight to future challenges involving travel through the atmosphere and space.
3. Aerospace engineers typically work in teams to design smaller components of a larger system. The success of the entire system relies on each component to function correctly and to interact correctly with each other.
4. Success often comes from learning from failures which is demonstrated throughout the history of aerospace development.

Performance Objectives

It is expected that students will:

- Create a historical perspective on Aerospace industry and Aerospace technology to provide context for subsequent curriculum lessons.
- Summarize historical precedence in problem solving.
- Explain cause and effect relationships in design.
- Explain that aerospace terminology and expanded history are integral parts of design.

Lesson 1.2: Physics of Flight (22 days)

Concepts Addressed in Lesson

1. Aircraft have fixed and moveable surfaces to control forces and change flight direction.
2. The center of gravity of an object is where its weight is concentrated.
3. Four major forces act on an aircraft flying in the Earth's atmosphere.
4. Atmospheric conditions impact aircraft performance.
5. Lift and drag are generated by fluid flow around an airfoil.
6. Aircraft performance can be simulated in a safe and cost effective environment.
7. Wind tunnels allow the performance of shapes to be tested in real fluid flow.
8. Gliders are designed to fly long distances without a system to produce thrust.

Performance Objectives

It is expected that students will:

- Determine the center of gravity location of an aircraft.
- Explain how aircraft are designed for stability and control.
- Design and analyze an airfoil considering lift and drag.
- Use the lift and draft equations to calculate associated forces and conditions.

- Describe the requirements for a glider to remain stable in flight.
- Design and construct a glider that meets the design requirements provided by the instructor.
- Summarize test data to evaluate glider performance against design criteria.

Lesson 1.3: Flight Planning and Navigation (18 days)

Concepts Addressed in Lesson

1. Simulations are widely used in the aerospace industry to develop skills which can be effectively applied to the actual device.
2. Each flight should be planned in advance of the actual flight.
3. Pilots then apply the principles of navigation to safely travel to their destinations.
4. The Global Positioning System, GPS, is a complex system designed to provide accurate location information to many users.
5. The history of navigation is intertwined with technology development.
6. Air traffic is coordinated within a complex system to improve safety and efficiency.

Performance Objectives

It is expected that students will:

- Explain the progression of navigation technology and its influence on navigation.
- Demonstrate aircraft control through the use of a flight simulator.
- Plan a flight and accurately navigate this plan using a flight simulator.
- Explain why simulators are valuable tools for preparing pilots to fly aircraft.
- Use the Global Positioning System, GPS, unit to navigate.

Unit 2: Aerospace Design

Time Days: 49 days

Lesson 2.1: Materials and Structures (20 days)

Concepts Addressed in Lesson

1. Aerospace material selection is based upon many factors including mechanical, thermal, electromagnetic, and chemical properties.
2. Structural design, including centroid location, moment of inertia, and a material's modulus of elasticity, are important considerations for an aircraft.
3. Static equilibrium occurs when the sum of all forces acting on a body is equal to zero.
4. Composites combine different materials to create a material with properties superior to that of

the individual materials.

5. Material testing provides a reproducible evaluation of material properties.

Performance Objectives

It is expected that students will:

- Research the properties of materials used in the aerospace industry.
- Calculate and use properties of material.
- Design and analyze a frame system 3D modeling software.
- Create composite material.
- Determine material properties through testing.

Lesson 2.2: Propulsion (18 days)

Concepts Addressed in Lesson

1. Energy transformed between forms of energy produces propulsion.
2. Newton's Three Laws of Motion are central to the idea of propulsion.
3. Engines vary in terms of efficiency, speed, and altitude.
4. Air and fuel are used for combustion.
5. Engine configuration impacts flight performance.
6. Rocket engines produce thrust through rapid expansion of gases.

Performance Objectives

It is expected that students will:

- Design an engine for an aircraft.
- Determine the thrust of an engine.
- Design an effective model rocket.
- Research and investigate rocket engines for use in a rocket.
- Test a model rocket to perform as predicted.
- Identify the main propulsion systems and the parts of a rocket engine.
- Compare the advantages and disadvantages of various rocket systems.
- Explain the rocket types used by various spacecraft.
- Explain how Newton's three laws of motion relate to rocket propulsion.

Lesson 2.3: Flight Physiology (11 days)

Concepts Addressed in Lesson

1. The capabilities and limitations of the human body need to be understood by pilots, crews, and aerospace engineers.
2. An aerospace engineer considers the human interaction with the machine for more effective designs.
3. The human body consists of systems that work together to ensure functionality and life.
4. Extreme environments and forces can harm or kill a human.

Performance Objectives

It is expected that students will:

- Determine individual human factors.
- Identify applications of human factors in aerospace engineering.
- Apply human factors in an aerospace engineering design.
- Explore an aviation accident and report on its causes.

Unit 3: Space

Time Days: 30 days

Lesson 3.1: Space Travel (11 Days)

Concepts Addressed in Lesson

1. The universe exists in a scale that is difficult to conceptualize.
2. Space law is a system based on international agreements designed to promote the use of space for the good of all humankind.
3. The exploration of space is successful through learning from previous missions and the development of technology and systems.

Performance Objectives

It is expected that students will:

- Describe the relative sizes of celestial bodies.
- Apply space law to an accident involving space hardware.
- Explain how technology development is intertwined into the culture of a nation.
- Design a space junk mitigation system.

Lesson 3.2: Orbital Mechanics (19 Days)

Concepts Addressed in Lesson

1. Orbital mechanics provides a means for describing orbital behavior of bodies.

2. The same laws that govern satellite orbits also govern celestial body (e.g. comets, planets and moons) orbits.
3. All objects exert an attraction force to each other.
4. Objects orbit other objects in a pattern governed by forces exerted on each other.
5. Objects in orbit are continuously falling toward the body about around which they orbit.
6. Orbital elements can be used to fully define a satellite's orbit, allowing the accurate prediction of the precise location of the satellite at a given time.
7. A satellite's mission is a major factor when designing its orbit.

Performance Objectives

It is expected that students will:

- Describe the contributions to orbital theory of the discipline's historical figures.
- Define the six orbital parameters that describe an orbit.
- Design and simulate the path of an orbiting body.
- Calculate the energy of an orbiting body.

Unit 4: Alternative Applications

Time: 44 Days

Lesson 4.1: Alternative Applications (11 Days)

Concepts Addressed in Lesson

1. Aerospace concepts traditionally considered applicable to flight can be used in a variety of applications and industries.
2. Fluid movement is an important consideration in the design of many products.
3. Air travel impacts society and the environment in many ways.
4. Efficiency is major criteria for aircraft design.

Performance Objectives

It is expected that students will:

- Apply aerospace engineering concepts into design or industries not intended for flight.
- Describe the impact of air travel on society and the environment.
- Apply concepts of the product life cycle to the aerospace industry.
- Identify alternative methods of sustainability for flight in the future.

- Justify the need for efficiency in design relating to cost and economic impact.

Lesson 4.2: Remote Systems (25 Days)

Concepts Addressed in Lesson

1. Remote system designs are used in air, ground, maritime, and space environments.
2. Remote system design is based upon the integrated system design of mechanical, electrical, and software systems.
3. Remote systems use sensor feedback to modify behavior.
4. Operator input is established through the use of an operator interface and a means to communicate with the remote system.
5. Remote systems can be designed to perform an extended operation with little human input or impact.

Performance Objectives

It is expected that students will:

- Describe the impact of a communication delay on the success of a mission.
- Design and create a functional remote system, including integration of structural, mechanical, electrical, and software systems.
- Demonstrate proper setup and operation of remote system sensor inputs.
- Interpret remote system data and create a visual data representation.
- Operate a remote system through a series of performance tasks including autonomous navigation.

Lesson 4.3: Aerospace Careers (8 Days)

Concepts Addressed in Lesson

1. Career planning should consider many factors.
2. Career planning should begin by exploring one's own interests and understanding possible options.
3. The wide variety of career paths available to students requires careful consideration for future professional success.

Performance Objectives

It is expected that students will:

- Develop a career plan to achieve their vision as a future professional.
- Conduct an interview with a professional.

- Prepare a presentation for peer review.

Assessment Methods and/or Tools

Assessment opportunities that enable continuous evaluation of student progress will be embedded in all areas of the course thus evaluation will be part of the learning process. Strategies for assessment will include:

- Daily/weekly work assignments.
- Performance-based assessment such as experiments, demonstrations, discussions-brainstorming and simulations.
- Writing assignments including research, investigation, justification for solutions, technical and project reports.
- Project grades.
- Cumulative portfolio exhibiting investigative processes to reaching solutions to design problems.
- Objective and performance based tests. •Teacher and peer evaluation.
- National PLTW Exam

Minimal Attainment For Student To Pass Course PLTW Certification

Students must meet the following requirements to receive PLTW certification:

Completed Portfolio
Completed Engineering Notebook
Minimum of 70% on class work and exams
Minimum of 70% on national final exam