STRANDS AND STANDARDS

AEROSPACE ENGINEERING

Course Description

Aerospace Engineering propels students' learning in the fundamentals of atmospheric and space flight. As they explore the physics of flight, students bring the concepts to life by designing an airfoil, propulsion system, and rockets. They learn basic orbital mechanics using industry-standard software. They also explore robot systems through projects such as remotely operated vehicles.

Core Code	38.01.00.00.350
Concurrent Enrollment Core Code	None
Units of Credit	1.0
Intended Grade Level	10-12
Prerequisite	None
Skill Certification Test Number	967
Test Weight	1.0
License Area of Concentration	Secondary Education
Required Endorsement(s)	Technology & Engineering, or
	Limited Engineering, or
	Engineering

STRAND 1

Students will gain an awareness of the development of Aerospace Engineering.

Standard 1

Deliver organized oral presentations of work tailored to the audience.

- Identify major Aerospace Engineering accomplishments.
- Describe trends in Aerospace Engineering.
- Analyze how Aerospace Engineering achievements were made.
- Predict how Aerospace Engineering achievements will impact future accomplishments.
- Synthesize discrete facts into a coherent sequence of events.

STRAND 2

Students will know the basic forces of flight and how they are controlled.

Standard 1

Identify major components of an aircraft.

- Approximate the center of gravity of geometric shapes.
- Identify the three axis of an aircraft.
- Label the motions about the three axis of an aircraft.
- Describe the four major forces which act on an aircraft.

Standard 2

Describe the factors that impact lift and drag.

- Label the components of an airfoil.
- Demonstrate how lift may be created with an airfoil.
- Describe the four ways that lift is generated by an airfoil.
- Describe the Earth's atmosphere composition and layers.
- Describe the relationship of altitude, temperature and pressure within the Earth's atmosphere.
- Calculate the values of Earth's atmosphere altitude, temperature and pressure relative to each other.
- Predict how aircraft characteristics affect lift, drag, and Reynolds Number.
- Calculate the values of lift, drag and Reynolds Number.

Standard 3

Explain factors which improve aircraft stability.

- Describe how the motions about the three axis of an aircraft are stabilized and controlled by aircraft components.
- Revise the weight and location of masses onboard an aircraft for safe flight balance.
- Calculate the center of gravity of an aircraft.

Standard 4

Design a glider to meet or exceed desired performance.

- Design an airfoil to meet or exceed desired performance.
- Summarize test data to evaluate glider performance against design criteria.
- Revise a glider to meet or exceed desired performance.
- Analyze the factors that contribute to a successful glider design.
- Accurately construct a glider that represents a design.
- Predict glider performance.
- Compare glider performance to predicted performance.
- Optimize glider performance to improve performance.

STRAND 3

Students will have a basic understanding of navigation.

Standard 1

Describe major advances in navigation technology.

- Identify components of common aviation navigation aids.
- Describe how an aircraft reacts to flight control inputs.
- Describe purpose of air traffic control system how it functions.

Standard 2

Explain how Global Positioning System (GPS) functions.

- Identify the functions of a typical Global Positioning System (GPS) unit functions.

Standard 3

Interpret an indication shown on a navigation aid.

- Illustrate navigation aid indication on a map.

Standard 4

Operate an aircraft in a simulated environment.

- Plan a flight route.
- Use a navigation aid to fly an aircraft to a destination in a simulated environment.
- Predict an aircraft collision based on aircraft vectors.
- Calculate an alternate aircraft vector for safe separation.

Standard 5

Create a route consisting of latitude and longitude waypoints using a Global Positioning System (GPS) unit.

- Interpret a route from latitude and longitude waypoints.

STRAND 4

Students will gain an understanding of materials used in Aerospace Engineering.

Standard 1

Describe common aerospace materials and their properties.

- Identify moment of inertia and Young's Modulus equations.

- Recognize the impact of loading conditions on a structure.
- Classify materials for aerospace applications.

Standard 2

Model a structure using a 3D modeling software.

- Analyze deformation of a structure as a result of force application.
- Design a structure that meets a given criteria.

Standard 3

Construct a composite structure.

- Measure mechanical properties of material.
- Interpret measurements of a tensile tester.
- Calculate moment of inertia and Young's Modulus equations.

STRAND 5

Students will have a basic understanding of rocket propulsion and space travel.

Standard 1

Describe the four primary forces acting on an aircraft.

- Explain how Newton's Third Law applies to aerodynamic forces.

Standard 2

Describe the characteristics of the four types of propulsion systems.

- Classify rocket engine systems.
- Identify the thrust and impulse equations.
- Describe parts and functions of a typical model rocket engine.
- Outline model rocket safety suggestions.
- Label model rocket components and functions.
- Recognize the equation of center of gravity and center of pressure.

Standard 3

Identify common space propulsion systems.

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Standard 4

Identify basic criteria to consider when designing a spacecraft.

Standard 5

Construct a physical model of a system.

- Measure mechanical properties of material.
- Interpret measurements of a test system.

Standard 6

Construct a stable model rocket.

- Simulate performance of propulsion systems.

- Design an aircraft propulsion system to meet a given objective such as maximum efficiency, maximum thrust to weight ratio.
- Infer how changes in propulsion system parameters affect performance.
- Interpret measurements of a model rocket engine thrust.
- Design a stable model rocket.
- Gather performance data associated model rocket launch such as maximum height of flight.
- Calculate maximum height using rocket engine test data and indirect height measurements.
- Select spacecraft components based on characteristics of each component.
- Select spacecraft landing system based on characteristics of each component.

STRAND 6

Students will consider human factors in design.

Standard 1

Describe common human body systems and their functions.

- Measure human vision quality such as acuity, astigmatism, color vision perception, depth perception and peripheral vision field.
- Analyze how human factors affect aerospace system design.
- Infer reaction time through indirect measurements.

Standard 2

Analyze an aircraft accident to determine likely causes.

- List common factors contribute to an aircraft accident.

STRAND 7

Students will learn about manmade objects in space.

Standard 1

Recognize common celestial groups such as galaxy, star and planet.

- Describe the relative sizes of celestial bodies.
- Explain how global governance applies to space issues.

Standard 2

Outline how past space faring achievements contributed to subsequent achievements.

- Describe how commercial organizations contribute to space related activities.
- Identify the impact that space junk has on space based activities.
- Design a system to mitigate space junk.
- Construct a prototype to demonstrate a design solution.

STRAND 8

Students will make elementary calculations describing orbital motion.

Standard 1

List major contributions made by people studying orbital mechanics.

- Describe common satellite orbital pattern shapes and applications.
- Explain Kepler's Laws.
- Name and describe the six Keplerian elements.
- Recognize the equations for orbital period, orbital gravitational potential energy, orbital kinetic energy, and total orbital energy.
- Analyze how an orbital mechanics theory can describe satellite motion.
- Identify the most appropriate orbital pattern for an application.

Standard 2

Model a satellite system using a modeling software.

- Describe how an orbital mechanics modeling software can be applied design a satellite system.
- Calculate an orbiting body's orbital period, orbital gravitational potential energy, orbital kinetic energy, and total orbital energy.

STRAND 9

Students will consider and improve efficiencies in design.

Standard 1

Design aerospace system as an alternate to an aircraft which use aerospace engineering concepts. Examples include a wind turbine and a parachute.

- Describe the parts and functions of a wind turbine.
- Identify factors that impact aircraft efficiency.
- Recognize the drag equation.

Standard 2

Construct an alternate aerospace system.

- Measure output of an alternate aerospace system.
- Optimize an alternate aerospace system.
- Explain aircraft efficiency affects aircraft design.

STRAND 10

Students will simulate a satellite mapping mission.

Standard 1

Outline how a satellite data is gathered and used to create a map.

- Describe how input and output devices function.
- Relate sensor input to the environment being measured.
- Operate output devices to perform a function.
- Explain the purpose of a flowchart or pseudocode.
- Create a flowchart or pseudocode to perform a task.

- Describe functions of a computer program.
- Identify how functions of a computer program can be applied to perform a task.

Standard 2

Describe how spacecraft systems function.

- Describe how human factors impact space travel.
- Analyze how aerospace unmanned systems function.

Standard 3

Recognize factors that affect communication with equipment in space.

- Describe the impact of a communication delay on the success of a mission.

Standard 4

Operate a remote system through a series of performance tasks including autonomous navigation.

Standard 5

Operate a simulated spaceflight.

- Construct a control program to accomplish a specified goal.
- Gather data using robot control software.
- Arrange data using spreadsheet software.

STRAND 11

Students will learn about the variety of careers in Aerospace Engineering.

Standard 1

Describe factors that a student should consider when planning a career.

- Outline questions as preparation to interview a professional.
- Collect information related to a future career.
- Interview a professional.
- Assemble career information into a coherent plan.
- Deliver organized presentations of work tailored to the audience.