AOPA 11th Grade Aviation STEM Curriculum Standard Alignment

Overview: This course will cover small unmanned aircraft performance, ethics, human factors, aeronautical decision-making and judgment, safety protocols, weight and balance, maintenance, aviation weather sources and effects of weather (micro-meteorology) on small unmanned aircraft performance, small unmanned aircraft loading and performance, emergency procedures, crew resource management, and preflight inspection procedures. Students will be provided the opportunity to participate in multiple practice examinations. Students will be prepared to complete the Federal Aviation Administration's Part 107 Remote Pilot Knowledge Test upon completion of this course.

UAS Track: UAS Operations, Semester 2

Unit 6 Introduction to Drones and UAS Operations

Description: In Unit 6, students will receive a broad overview of the world of unmanned flight, and a preview of what is to come in the course. This will include a first look at common UAS components, and an explanation of how different types of drones fly. Next, students will learn about Part 107: the types of flying it applies to, the certification process, and the regulations with which commercial drone operators must be familiar. Finally, students will look beyond Part 107 at privacy issues that have arisen with the popularity of drones, as well as best practices remote pilots should follow to be good neighbors.

Next Generation Science Standards

Three-dimensional Learning

- **HS-ETS1-3** - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
    - Science and Engineering Practices
        - Constructing Explanations and Designing Solutions
    - Disciplinary Core Ideas
        - ETS1.B: Developing Possible Solutions
    - Crosscutting Concepts
        - None

Common Core State Standards

- **RST.11-12.2** - Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
- **RST.11-12.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*.
- **WHST.11-12.6** - Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

- **WHST.11-12.8** - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
- **WHST.11-12.9** - Draw evidence from informational texts to support analysis, reflection, and research

FAA Airman Certification Standards

Remote Pilot

I. Regulations, Task A. General

- Knowledge The applicant demonstrates understanding of:
  - **UA.I.A.K1** Applicability of 14 CFR part 107 to small unmanned aircraft operations.
  - **UA.I.A.K2** Definitions used in 14 CFR part 107.
  - **UA.I.A.K3** The ramifications of falsification, reproduction, or alteration of a certificate, rating, authorization, record, or report.
  - **UA.I.A.K4** Accident Reporting.
  - **UA.I.A.K5** Inspection, testing, and demonstration of compliance.

I. Regulations, Task B. Operating Rules

- Knowledge The applicant demonstrates understanding of
  - **UA.I.B.K1** Registration requirements for sUAS.
  - **UA.I.B.K2** Requirement for the sUAS to be in a condition for safe operation.
  - **UA.I.B.K3** Medical condition(s) that would interfere with safe operation of an sUAS.
  - **UA.I.B.K4** Responsibility and authority of the remote PIC.
    - UA.I.B.K4a a. Allowing a person other than the remote PIC to manipulate the flight controls.
  - **UA.I.B.K5** Regulatory deviation and reporting requirements for in-flight emergencies.
  - **UA.I.B.K6** Hazardous operations.
    - UA.I.B.K6a a. Careless or reckless
    - UA.I.B.K6b b. Dropping an object
  - **UA.I.B.K7** Operating from a moving aircraft or moving land- or water-borne vehicle.
  - **UA.I.B.K8** Alcohol or drugs and the provisions on prohibition of use.
  - **UA.I.B.K9** Daylight operation.
  - **UA.I.B.K10** Visual line of sight (VLOS) aircraft operations.
  - **UA.I.B.K11** Requirements when a visual observer is used.
  - **UA.I.B.K12** Prohibition of operating multiple sUAS.
  - **UA.I.B.K13** Prohibition of carrying hazardous material.
  - **UA.I.B.K14** Staying safely away from other aircraft and right-of-way rules.
    - UA.I.B.K14a a. See and avoid other aircraft and other potential hazard considerations of the remote PIC
  - **UA.I.B.K15** Operations over human beings.
  - **UA.I.B.K16** Prior authorization required for operation in certain airspace.

- **UA.I.B.K17** Operating in the vicinity of airports.
- **UA.I.B.K18** Operating in prohibited or restricted areas.
- **UA.I.B.K19** Flight restrictions in the proximity of certain areas designated by notice to airmen (NOTAM).
- **UA.I.B.K20** Preflight familiarization, inspection, and actions for aircraft operations.
- **UA.I.B.K21** Operating limitations for sUAS.
  - UA.I.B.K21a a. Maximum groundspeed
  - UA.I.B.K21b b. Altitude limitations
  - UA.I.B.K21c c. Minimum visibility
  - UA.I.B.K21d d. Cloud clearance requirements
- **UA.I.B.K22** Requirements for a Remote Pilot Certificate with an sUAS rating.

I. Regulations, Task C. Remote Pilot Certification with an sUAS rating

- Knowledge The applicant demonstrates understanding of
  - **UA.I.C.K1** Offenses involving alcohol or drugs.
  - **UA.I.C.K2** The consequences of refusing to submit to a drug or alcohol test or to furnish test results.
  - **UA.I.C.K3** The eligibility requirements for a Remote Pilot Certificate with an sUAS rating.
  - **UA.I.C.K4** Aeronautical knowledge recency.

I. Regulations, Task D. Waivers

- Knowledge The applicant demonstrates understanding of:
  - **UA.I.D.K1** Waiver policy and requirements.

Unit 7 Operational Decision Making

Description: In Section A of Unit 7, students will learn ways in which topics they have been introduced to before, such as weather theory and aerodynamics, relate specifically to sUAS operations. Next, in Section B, they will continue to learn how effective crew management is essential to these operations. Students will learn both regulatory requirements and best practices for preflight inspections and drone maintenance, and how crew resource management plays a vital role in UAS missions. At the close of the unit, students will look at how to handle common UAS emergencies, as well as the various human factors involved in UAS flight.

Next Generation Science Standards

Three-dimensional Learning

- **HS-ETS1-2** - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
    - Science and Engineering Practices
        - Constructing Explanations and Designing Solutions
    - Disciplinary Core Ideas
        - ETS1.A: Defining and Delimiting Engineering Problems
    - Crosscutting Concepts
        - None
- **HS-ETS1-3** - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
    - Science and Engineering Practices
        - Constructing Explanations and Designing Solutions
    - Disciplinary Core Ideas
        - ETS1.B: Developing Possible Solutions
    - Crosscutting Concepts
        - None

Common Core State Standards

- **RST.11-12.2** - Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
- **RST.11-12.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*.
- **RST.11-12.7** - Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
- **RST.11-12.9** - Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
- **WHST.11-12.6** - Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
- **WHST.11-12.7** - Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- **WHST.11-12.8** - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
- **WHST.11-12.9** - Draw evidence from informational texts to support analysis, reflection, and research

FAA Airman Certification Standards

Remote Pilot

I. Regulations, Task B. Operating Rules

- Knowledge The applicant demonstrates understanding of
  - **UA.I.B.K2** Requirement for the sUAS to be in a condition for safe operation.
  - **UA.I.B.K9** Daylight operation.
  - **UA.I.B.K10** Visual line of sight (VLOS) aircraft operations.
  - **UA.I.B.K20** Preflight familiarization, inspection, and actions for aircraft operations.
  - **UA.I.B.K21** Operating limitations for sUAS.
    - UA.I.B.K21a a. Maximum groundspeed
    - UA.I.B.K21b b. Altitude limitations
    - UA.I.B.K21c c. Minimum visibility
    - UA.I.B.K21d d. Cloud clearance requirements

III. Weather, Task A. Sources of Weather

- Knowledge The applicant demonstrates understanding of:
  - **UA.III.A.K1** Internet weather briefing and sources of weather available for flight planning purposes.
  - **UA.III.A.K2** Aviation routine weather reports (METAR).
  - **UA.III.A.K3** Terminal aerodrome forecasts (TAF).
  - **UA.III.A.K4** Weather charts.
  - **UA.III.A.K5** Automated surface observing systems (ASOS) and automated weather observing systems (AWOS).

III. Weather, Task B. Effects of Weather on Performance

- Knowledge The applicant demonstrates understanding of:
  - **UA.III.B.K1** Weather factors and their effects of performance:
    - UA.III.B.K1a a. Density altitude
    - UA.III.B.K1b b. Wind and currents
    - UA.III.B.K1c c. Atmospheric stability, pressure, and temperature
    - UA.III.B.K1d d. Air masses and fronts
    - UA.III.B.K1e e. Thunderstorms and microbursts
    - UA.III.B.K1f f. Tornadoes
    - UA.III.B.K1g g. Icing
    - UA.III.B.K1h h. Hail U
    - A.III.B.K1i i. Fog
    - UA.III.B.K1j j. Ceiling and visibility
    - UA.III.B.K1k k. Lightning

IV. Loading and Performance, Task A. Loading and Performance

- Knowledge The applicant demonstrates understanding of:
  - **UA.IV.A.K1** General loading and performance:
    - **UA.IV.A.K1a** a. Effects of loading changes
    - **UA.IV.A.K1b** b. Balance, stability, and center of gravity
  - **UA.IV.A.K2** Importance and use of performance data to calculate the effect on the aircraft's performance of an sUAS.

Unit 8 Becoming a Commercial sUAS Pilot

Description: In this unit, students will revisit topics that they learned in the first semester of 11th grade, including airspace and navigation, airport operations, radio communications, and weather theory. These are topics that don't apply to sUAS exclusively, but are necessary for all pilots. For the review, students will divide into groups and research the various topics, and then each group will find a creative way to teach the class the material. At the end of Unit 8, students will be prepared to take the FAA's Part 107 exam and earn their commercial sUAS certification.

Common Core State Standards

- **RST.11-12.2** - Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
- **RST.11-12.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*.
- **RST.11-12.7** - Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
- **RST.11-12.9** - Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
- **WHST.11-12.2** - Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
- **WHST.11-12.4** - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- **WHST.11-12.6** - Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
- **WHST.11-12.7** - Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- **WHST.11-12.8** - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
- **WHST.11-12.9** - Draw evidence from informational texts to support analysis, reflection, and research.

Unit 9 From Theory to Practice: Planning and Executing a Mission

Description: Unit 9, as its title suggests, will give students a chance to apply the knowledge they've learned in the course by learning to fly drones and taking part in simulated sUAS operations. The unit will begin with an in-depth look at the systems involved in UAS, including controllers, propulsion, and electrical systems. Next, students will learn about different types of drone imaging sensors. After covering important aspects of UAS safety, students will have opportunities to get hands-on experience flying a drone. In Section B, students will apply what they have learned throughout the semester to perform real-world sUAS operations as teams. Each team will work with a client (either their school or another local organization) to provide a beneficial product or service using a drone. This will give students the opportunity to plan an sUAS operation from the ground up, to fly it, and to present a valuable deliverable to a client—all of which are skills that they would use day to day as professional remote pilots.

Next Generation Science Standards

Three-dimensional Learning

- **HS-ETS1-2** - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
  - Science and Engineering Practices
    - Asking Questions and Defining Problems
    - Constructing Explanations and Designing Solutions
  - Disciplinary Core Ideas
    - ETS1.A: Defining and Delimiting Engineering Problems
  - Crosscutting Concepts
    - None

- **HS-ETS1-3** - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
  - Science and Engineering Practices
    - Constructing Explanations and Designing Solutions
  - Disciplinary Core Ideas
    - ETS1.B: Developing Possible Solutions
  - Crosscutting Concepts
    - Influence of Science, Engineering, and Technology on Society and the Natural World

- **HS-ETS1-4** - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
  - Science and Engineering Practices
    - Using Mathematics and Computational Thinking
  - Disciplinary Core Ideas
    - ETS1.B: Developing Possible Solutions

- Crosscutting Concepts
  - Systems and System Models

Common Core State Standards

- **RST.11-12.2** - Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
- **RST.11-12.3** - Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
- **RST.11-12.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*.
- **RST.11-12.7** - Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
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