TN Department of Education | College, Career and Technical Education

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Aviation I: Principles of Flight

Primary Career Cluster:	Transportation
Course Contact:	CTE.Standards@tn.gov
Course Code(s):	C20H16
Prerequisite(s):	*Introduction to Aerospace* (C20H15)
Credit:	1
Grade Level:	10-11
Elective Focus - Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Transportation courses.
POS Concentrator:	This course satisfies one out of two required courses that meet the Perkins V concentrator definition, when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the second course in the *Aviation Flight* program of study.
Aligned Student Organization(s):	SkillsUSA: http://www.skillsusatn.org/
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://www.tn.gov/education/career-and-technical-education/work-based-learning.html.
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/career-and-technical-education/student-industry-certification.html
Teacher Endorsement(s):	594, 774
Required Teacher Certifications/Training:	FAA Industry Certification
Teacher Resources:	https://www.tn.gov/education/career-and-technical-education/career-clusters/cte-cluster-transportation-distribution-logistics.html Best for All Central: https://bestforall.tnedu.gov/

Approved April 10, 2015; Amended January 31, 2018

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st century skills necessary to be successful in career and in life. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards which feed into intentionally designed programs of study.

Students engage in industry relevant content through general education integration and experiences such as Career & Technical Student Organizations (CTSO) and Work-based Learning (WBL). Through these experiences, students are immersed with industry standard content and technology, solve industry-based problems, meaningfully interact with industry professionals and use/produce industry specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course, note this is not an exhaustive list.

- Participate in CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry specific skills that involve teamwork and project management.
- Participate in contests that highlight job skill demonstration. These include Career Pathways Showcase, Job Interview, Commercial sUAS Drone, and Aviation Maintenance Technology.

Using a Work-based Learning (WB) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-1.2** | Include a safety briefing in a visit to an airport.
- **Standard 3.1-3.6 |** Have a pilot and maintenance technician visit the class to talk about aircraft structures and systems.
- **Standards 4.1-4.2** | Ask a pilot to discuss the flight environment with the class.
- **Standards 8.1-8.10** | On an airplane, ask a pilot or crew member to talk with the students about navigation.

Course Description

Aviation I: Principles of Flight builds on the fundamental knowledge and skills learned in *Introduction to Aerospace* while teaching students the essential competencies needed for flight under normal conditions. Upon completion of this course, proficient students will be able to apply knowledge, skills, and procedures in a variety of simulated flight environments. Moreover, students who complete this course will have the opportunity to move on to advanced study in *Aviation II: Advanced Flight*, where they will continue to prepare for the FAA Private Pilot written exam.

Course Standards

1. Aviation Safety

1.1. Safety: Identify the **basic safety issues** a pilot must be aware of **before, during, and after each flight**, including but not limited to: pilot's mental and physical condition, collision avoidance, weather conditions, maintaining minimum safe altitudes, visual scanning, wake turbulence, right-of-way rules, flight over hazardous terrain, positive exchange of flight controls, preflight planning, fuel requirements, post flight analysis, and operating within the Federal Aviation Regulations (FARs). Discuss takeaways to incorporate into future decision making and thought processes that would help in preparation to be a safer pilot or mechanic.

1.2. Accident: Evaluate at least one aviation **National Transportation Safety Board (NTSB) accident report** and share with the class the NTSB findings, probable causes of the accident, and any NTSB recommendations based on their findings. Devise strategies for being a safer pilot or mechanic based on what they learned.

2. Aerodynamics

2.1 Aerodynamics: Explain the **interrelationships among aerodynamics forces** that affect an aircraft on the ground and in flight. Aerodynamic forces include, but are not limited to: ground effect, torque and P-factor, load factor, and aircraft stability. In addition, be able to explain the effects of frost, the significance of angle of attack as it relates to stalls and spins, and how load factors are affected by airplane turns.

3. Aircraft Structures/Systems

3.1 Components: Describe the characteristics and functions of an **airplane's aileron, elevator, and rudder**, including the trim system if appropriate, citing technical manuals and industry guidelines. Detail the varying effects of changes in airspeed, density altitude, frost, snow, or ice on each of these functions. Explain the operation of aircraft slats, spoilers, speed brakes, and thrust reversers.

3.2 Engine: Compare and contrast the characteristics and operating principles of both a **normally aspirated and turbocharged aircraft reciprocating engine** then relate the advantages and disadvantages of each. Explain **how a turbine engine operates**, including

the different sections within the engine, and relate the advantages and disadvantages between a turbo jet, turbo fan, and turbo prop engine.

3.3 Systems: Describe the characteristics and chief functions of the following **aircraft systems or instrumentation systems**: pitot-static system, vacuum system, flight gyros, navigation radios (such as VOR and GPS), and aircraft communications radios. In the context of a specific aircraft, explain the advantages and disadvantages of a glass cockpit versus steam gauges.

3.4 Fuel: Describe the **fuel system in a typical training aircraft**, highlighting at minimum the following elements: fuel tanks, fuel selector valve, fuel drains, fuel pump(s), carburetor, and fuel injected systems. Distinguish between different types of aviation fuels by sight, color, and/or smell, and determine which type of fuel would be acceptable to use in a reciprocating and/or turbine aircraft engine.

3.5 Electrical System: Describe the **electrical system in a typical training aircraft**, highlighting at minimum the following elements: battery, alternator/generator, circuit breakers (CBs), and 12-volt and 24-volt systems.

3.6 Landing Gear: Describe how a **retractable landing gear system** operates in a typical training aircraft, citing aircraft handbooks and other manuals for illustration during normal operation procedures as well as emergency operation procedures. Describe or illustrate the differences between electrical pump versus hydraulic pump systems.

4. Flight Environment

4.1 Airspace: Explain the **restrictions associated with each classification of airspace**: Class A, B, C, D, E, G, Airport Advisory Areas, prohibited or restricted airspace, alert areas, warning areas, and MOCAs. Articulate what relevant laws and regulations govern and apply to airspaces as set forth by the Federal Aviation Regulations.

4.2 Components of Flight Environment: Describe the functions of and explain the differences between each of the following **aspects of the flight environment**: Clearance Delivery, Ground Controls, Towers, Approach/Departure Controls, Terminal Radar Programs, Air Route Traffic Centers (ARTC), and Flight Service Stations (FSS).

5. Communications

5.1 Communications: Explain the **communication** involved in the following scenarios:

a. **Controlled airport – Departure**
   - i Automated Terminal Information Service (ATIS)
   - ii. Clearance Delivery (assigned headings, altitudes, transponder codes, departure frequencies)
   - iii. Ground Control (taxi instructions)

iv. Tower (Visual Flight Rules (VFR) flight plan activation)
v. Departure Control

b. **Controlled airport – Arrival**
   i. ATIS
   ii. Approach Control
   iii. Tower
   iv. VFR flight plan closure
   v. Ground Control (taxi instructions)

c. **Non-controlled airport – Departure**
   i. Automated Weather Observing System (AWOS)
   ii. Common Traffic Advisory Frequency (CTAF) / Unicom (pre-taxi communication, pre-takeoff communication)
   iii. Proceeding on course
   iv. VFR Flight Plan Activation

d. **Non-controlled airport – Arrival**
   i. AWOS
   ii. CTAF / Unicom (airport advisory, pre-pattern communication, pattern communication, base communication, clearing runway communication)
   iii. VFR flight plan closure

6. Human Factors

6.1 <u>Human Factors:</u> Demonstrate understanding of the **five hazardous thoughts and associated antidotes** to each of the following:

a. Anti-authority
b. Impulsivity
c. Invulnerability
d. Macho
e. Resignation

Students will determine if they have one or more of these hazardous thoughts and explain what they do to realize when their decisions may be influenced by a hazardous thought. Students should also explain how they will counteract this thought in order to remain as safe as possible.

7. Weather

7.1 <u>Weather:</u> Retrieve and synthesize **weather information in a timely fashion to aid in aviation decision-making**: Aviation Routine Weather Report (METAR)s, Pilot Weather Reports (PIREP)s, Aviation Area Forecast, Terminal Aerodrome Forecast (TAF). Make appropriate go/no go weather decisions based on the information retrieved. Demonstrate different ways to obtain a weather briefing while on the ground (phone call to FSS, internet, or Aviation App), and explain what a pilot should do to get an updated weather briefing while airborne (FSS, Aviation App, ATC, or XM Weather). Pilots should always be aware of limitations associated with receiving in air weather information.

8. Navigation

8.1 Best Route: Determine the different **factors involved in planning the best route** on each leg of a cross-country flight. For each factor, describe why it should be considered when determining the route, citing, by contrast, what could go wrong if the factor was not considered. Examples include the following:

a. Shortest distance
b. Lowest terrain
c. Best emergency landing options
d. Smoothest air

8.2 Best Altitude: Determine the different **factors involved in calculating the best altitude** to fly on each leg of a cross-country flight. Factors may include the following:

a. VFR – Easterly heading (odd thousand + 500') or Westerly heading (even thousand + 500')
b. IFR – Easterly heading (odd thousand) or Westerly heading (even thousand) (below FL 290)
c. Distance between departure airport and destination airport
d. Headwind/tailwind components at different altitudes
e. Terrain features
f. Emergency landing options
g. Smoothest air

8.3 Headwind and Tailwind: Given a specific flight route, **determine the headwind/tailwind** component on each leg of a cross-country flight. Specifically,

a. Determine forecast winds aloft for each leg
b. Determine best altitude for each leg
c. Determine headwind/tailwind component for each leg

8.4 Groundspeed: Given a specific flight route, **determine the estimated groundspeed** on each leg of a cross-country flight. Specifically,

a. Determine altitude
b. Determine true airspeed (TAS)
c. Determine headwind/tailwind component
d. Determine crosswind component
e. Determine estimated groundspeed (GS)

8.5 Magnetic Heading: Given a specific flight route, **determine the estimated magnetic heading** required for each leg of a cross-country flight. Specifically,

a. Determine True Course (TC) / Magnetic Course (MC)
b. Determine crosswind component
c. Determine True Heading (TH)
d. Determine amount of variation; show how to add variation if it is a Westerly variation and subtract variation if it is an Easterly variation
e. Determine Magnetic Heading (MH)

8.6 Visual Flight Rules (VFR) Flight Plan: Correctly simulate how to complete, file, activate, and close or cancel a **VFR flight plan**, following proper procedures and determining the information requested in each box of the flight plan.

8.7 Communications and Navigation Systems: Describe how to use the **communication radios and navigation systems**. Identify limitations as to their useful range. Explain the process around confirming that each radio or equipment is in working condition per the manufacture's operating manual or normal operation procedures. Student will also understand and explain the following transponder codes (1200, 7700, 7600, and 7500) and be able to list what each code communicates to ATC, as well as the function of Mode C and "Ident" button.

8.8 Global Positioning System (GPS): Accurately express how the basic **GPS system** works in an aircraft and cite specific **principles of operation** to determine the advantages and disadvantages of GPS navigation over the VOR system.

8.9 Aeronautical Charts: Clearly explain how to use **aeronautical charts** during a cross country flight to determine aircraft's position by use of Pilotage and Dead Reckoning (DR). Demonstrate proficiency in the use of lines of latitude and longitude to determine checkpoints or landmarks on an aeronautical chart, and be able to input that information into a GPS for navigation purposes. Analyze the information retrieved to determine the necessary radio frequencies listed, the different types of airspace, and the altitudes of that airspace by using a sectional and/or world aeronautical chart.

8.10 Very High Frequency Omni-Directional Range (VOR): Understand and be able to clearly explain how to use a **VOR for navigation purposes**, determine an aircraft's position, and determine the Radial From a VOR facility and Bearing To a VOR facility. Additionally, determine when an aircraft crosses over a VOR station.

9. Aircraft Performance and Weight & Balance

9.1 Density Altitude Impact: Describe the **effects of density altitude on aircraft performance**. Given a particular set of conditions, determine and accurately perform density altitude computations.

9.2 Headwind, Tailwind, and Crosswind During Takeoff and Landing: Determine the **headwind/tailwind and crosswind components for takeoff and landing**. Explain how each component was determined; based on the analysis, evaluate if the crosswind component is within the manufacturer's approved or demonstrated crosswind component.

9.3 Takeoff Distances: Determine the required **takeoff run and takeoff distance** to clear a fifty-foot obstacle, required landing roll and landing distance to clear a fifty-foot obstacle distances based on projected aircraft weight, headwind/tailwind component, density altitude, and surface conditions.

9.4 Cruise Setting: Determine **aircraft cruise power settings**. Explain how different cruise power settings were determined, citing the advantages and disadvantages of each.

9.5 Weight and Balance: Confirm that the projected weight is within the manufacturer's approved maximum takeoff and landing weights and that the center of gravity is within the manufacturer's approved takeoff Center of Gravity (CG) envelope. Explain **weight and balance definitions** and relate how to reduce the payload as needed to bring the aircraft within the manufacturer's approved maximum takeoff weight. Determine how to move passengers and/or cargo to bring the center of gravity within the manufacturer's approved takeoff CG envelope.

Standards Alignment Notes

*References to other standards include:

- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.