Department of Education | College, Career and Technical Education

Published May 2021

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: https://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 1-2** | Include a safety briefing in a visit to an airport.
- **Standard 3 |** Have a pilot and maintenance technician visit the class to talk about careers.
- **Standards 12-15** | Ask a pilot to discuss the flight environment with the class.
- **Standards 16-18** | Ask a pilot to discuss situations they have experienced.
- **Standards 24-28** | On an airplane, ask a navigator to talk with the students.

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.

Program of Study Application

This is the second course in the *Aviation Flight* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Transportation, Distribution, & Logistics website at https://www.tn.gov/education/career-and-technical-education/career-clusters/cte-cluster-transportation-distribution-logistics.html.

Course Standards

Safety

1) Gather information from a variety of print and digital sources (such as textbooks, aviation magazines, publications, and industry websites) and write a report based on what the aviation industry is doing to enhance aviation safety. Discuss takeaways to incorporate into future decision making and thought processes that would help in preparation to be a safer pilot or mechanic.

2) Gather information from a variety of print and digital sources (such as textbooks and online industry publications) on the National Transportation Safety Board (NTSB), its purpose, and how the organization performs its duties. Explain how aviation safety is enhanced by NTSB investigations of aircraft accidents. Read and evaluate at least one aviation NTSB accident report and share with the class the NTSB findings, probable causes of the accident, and any NTSB recommendations based on their findings. Students should personalize what they learned from their research to devise strategies for being a safer pilot or mechanic based on what they learned.

Careers

3) Research collegiate websites and affiliated publications to create a list of postsecondary educational opportunities that prepare students for careers in aviation. Evaluate personal career goals and desires, then determine which opportunity would provide the best preparation for the desired career. Develop a timeline detailing the postsecondary path that will lead to career goals.

Aerodynamics

4) Research industry manuals and course materials to 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.

Aircraft Systems

5) 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. Illustrate the operation of aircraft slats, spoilers, speed brakes, and thrust reversers.
6) Compare and contrast the characteristics and operating principles of both a normally aspirated and turbocharged aircraft reciprocating engine, and 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.

7) Draw on technical manuals and manufacturers' guidelines to 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, ADF, 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.
8) Deliver an oral presentation or guided explanation of 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.

9) Deliver an oral presentation or guided explanation of 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.

10) 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 pump versus hydraulic pump systems.

11) Research studies on the effectiveness of anti-skid brake systems. Craft an original argument comparing the advantages and disadvantages of these systems, providing a precise explanation of how they operate and whether they conform to industry safety regulations. Share findings in a written or oral format.

Flight Environment

Note: The following standards can be used to meet TN Writing Standard 2 when specifically incorporating a writing assignment in which students write to inform or explain a technical process, concept, or procedure.

12) Gather information from a variety of print and digital sources (such as textbooks, aviation magazines, publications, and industry websites) to synthesize concepts related to the formation of weather, convective currents, fronts, and associated meteorological dangers. Discuss the explicit dangers, causes, and effects of thunderstorms; discuss airframe and carburetor icing; mountain waves; wind shear; and temperature/dew point. Describe the

factors involved in the formation and dissipation of fog, temperature inversions, and clouds. Apply mathematics concepts to determine the stability or instability of an air mass.

13) Outline the restrictions associated with each classification of airspace: Class A, B, C, D, 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.

14) Describe the functions of and explain the differences between each of the following aspects of the flight environment: ATIS, AWOS, Clearance Delivery, Ground Controls, Towers, Approach/Departure Controls, Terminal Radar Programs, Air Traffic Centers (ATC), and Flight Service Stations (FSS). Demonstrate different ways to obtain a weather briefing while on the ground (phone call to FSS, internet, TV, etc.), and explain what a pilot should do to get an updated weather briefing while airborne (FSS, Flight Watch, ATC, XM Weather, etc.).

15) Analyze the following texts, synthesize the information found, and demonstrate the ability to retrieve the correct 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)s, Weather Depiction Charts, Radar Summary Charts and Radar Weather Reports, En route Flight Advisory Service (EFAS), Wind and Temperature Aloft Forecasts (FB), Significant Weather Prognostic Charts, AIRMETs and SIGMETs. Given a scenario designed by the instructor, make the appropriate go/no go decision based on the information retrieved.

Complex and Abnormal Procedures

Note: The following standards may require flight simulation equipment or training within another simulated environment in order to fully meet the range of activities outlined below.

16) Demonstrate understanding of various complex and abnormal procedures and be able to accurately perform the correct procedures given a particular set of conditions, including but not limited to procedures relating to stalls and/or spins recovery, engine failures, engine fires, abnormal combustion, carburetor icing, loss of oil pressure, low oil pressure, high oil and/or CHT temperature(s), aircraft wake turbulence, deteriorating weather conditions, low fuel situations, and medical issues with pilot and/or passengers.

17) Synthesize guidelines from piloting manuals to explain and demonstrate the operation of a constant speed propeller system, compass turning, correction of acceleration/deceleration errors, correction of altimeter errors, proper use of EGT for accurate leaning purposes, and navigation at different types of altitudes.

18) Explain the terminology, outline basic procedures, and demonstrate the ability to perform procedures related to the following:
    a. Visual Approach Slope Indicators (VASI)
    b. Runway markings
    c. Taxiway and destination signs
    d. Beacons and taxiway lights
    e. ATC traffic advisories
    f. ATC light signals

g. ELT's and VHF/DR steers
h. Land and Hold Short Operations (LAHSO)
i. Flying rectangular courses
j. Flying S-turns across a road

Communications

19) Role-play the protocol required for both air and ground communications. Communications include normal, abnormal, and emergency situations for the following: departing and arriving at non-controlled airports, departing and arriving at controlled airports, communicating with ATC, and requesting and receiving enroute weather from a Flight Service Station or Flight Watch. Explain each ATC light signal and the significance to the pilot.

20) Role-play use of the correct aviation terminology and radio phraseology required during all aspects of a flight, including but not limited to: receiving the current aircraft weather before starting the engine(s); calling ground control for a taxi clearance before taxiing, or advising traffic on the common traffic advisory frequency; and requesting a takeoff/landing clearance.

Physiology, Aeronautical Decision Making (ADM), and Judgment Training

21) Demonstrate understanding of, recognize the symptoms of, and react properly to the following aeromedical factors affecting a pilot, including but not limited to: pressure effects, ear and sinus blockage, toothaches, stress, fatigue, noise, alcohol/drugs, hypoxia, hyperventilation, spatial disorientation, vision issues, and carbon monoxide poisoning. Perform a preflight self-inspection and determine airworthiness based on an appropriate rubric provided by the instructor.

22) The goal of developing the skills required to make wise decisions is to increase safety. Develop a clear and systematic ADM system, or outline a plan to manage the human factors which may affect whether a safe or unsafe outcome occurs in the course of flight. Consult recommendations and best practices endorsed by industry to guide the process. Students should develop a flow chart showing the proper steps and factors involved in making effective and timely decisions, including at minimum protocols for assessing pilot-in-command responsibility, communication, workload management, resource use, and situational awareness.

23) Build upon principles previously learned and continue to refine one's thought process relating to judgment training. Based on experiences in this course, compose an essay demonstrating a pilot's good judgment(s) relating to a challenging in-flight situation.

Navigation

24) Accurately describe how to use the communication radios, navigation radios, ADF, DME, transponder, ELT, and autopilot (if aircraft so equipped), and be able to list any 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.

25) 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 and NDB systems.

26) Clearly explain how to use sectional and world aeronautical charts during a cross country flight to determine aircraft's position by use of pilotage and dead reckoning (DR). Given an appropriate scenario provided by the instructor, demonstrate proficiency in the use of lines of longitude and latitude to determine checkpoints or landmarks on a sectional and/or world 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.

27) Gather information from a variety of publications such as FAA Advisory Circulars, Airport/Facility Directories, and Notices to Airmen Publications (NTAP) and be able to communicate that information to other crew members in order to successfully plan and fly to a desired cross-country destination safely.

28) Understand and be able to clearly explain how to use a VOR for navigation purposes, determine an aircraft's position, and determine the radial distance from a VORTAC facility. Additionally, determine when an aircraft crosses over a VOR station. Apply this knowledge to use a VOT and/or a VOR in the process of determining whether the VOR is within the accuracy requirements in the FARs.

Predicting Aircraft Performance and Weight & Balance

29) Describe the effects of density altitude on aircraft performance, drawing on technical aids and course materials. Given a particular set of conditions, determine and accurately perform density altitude computations.

30) Consult aircraft manuals, tables, and charts to accurately determine aircraft cruise power settings. Explain in a mock communications scenario with a superior how different cruise power settings were determined, citing the advantages and disadvantages of each.

31) Consult aircraft manuals, tables, and charts to accurately determine the headwind/tailwind and crosswind components. Report on how each component was determined; based on the analysis, evaluate if the crosswind component is within the manufacturer's approved or demonstrated crosswind component.

32) Consult aircraft manuals, tables, and charts to accurately determine the required takeoff run distance based on projected aircraft weight, headwind/tailwind component, density altitude, and surface conditions; demonstrate to peers how the takeoff distance was determined.

33) Consult aircraft manuals, tables, and charts to accurately determine the required takeoff distance to clear a fifty-foot obstacle based on projected aircraft weight, headwind/tailwind

component, density altitude, and surface conditions; demonstrate to peers how the takeoff distance was determined.

34) Consult aircraft manuals, tables, and charts to accurately determine the required landing roll distance based on projected aircraft weight, headwind/tailwind component, density altitude, and surface conditions; demonstrate to peers how the landing distance was determined.

35) Consult aircraft manuals, tables, and charts to accurately determine the required landing distance to clear a fifty-foot obstacle based on projected aircraft weight, headwind/tailwind component, density altitude, and surface conditions; demonstrate to peers how the landing distance was determined.

36) Consult aircraft manuals, tables, and charts to accurately confirm that the projected weight is within the manufacturer's approved maximum takeoff weight and that the center of gravity is within the manufacturer's approved takeoff CG envelope. Citing examples drawn from textbooks and manuals, 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. Additionally, determine how to move passengers and/or cargo to bring the center of gravity within the manufacturer's approved takeoff CG envelope.

37) Consult aircraft manuals, tables, and charts to accurately confirm that the projected weight is within the manufacturer's approved maximum landing weight and that the center of gravity is within the manufacturer's approved landing CG envelope. Citing examples drawn from textbooks and manuals, demonstrate how to reduce the payload before takeoff as needed to bring the aircraft within the manufacturer's approved maximum landing weight. Additionally, determine how to move passengers and/or cargo to bring the center of gravity within the manufacturer's approved landing 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.