I. INTRODUCTION

A. The first flight instruments were primitive altimeters and compasses. Today, even small general aviation aircraft have sophisticated instruments that allow the pilot to know their exact location and monitor aircraft performance. Much instrumentation uses solid-state electronics and micro-computer technology. This course will explore aircraft instruments and electronic flight instrument systems including installation and testing; inspecting and troubleshooting navigation and communication systems; inspecting and repairing antennas and electronic equipment installations.

B. This is a required course of study for the Associate Degree of Applied Science in Aviation Maintenance Technology.

C. This course is occupationally related and serves as preparation for careers in the field of Aviation Maintenance.

D. Prerequisite: None

II. LEARNING OUTCOMES

Upon successful completion of this course, Instruments and Navigation/Communication, the student will:

Inspect, test, troubleshoot and repair flight instrument systems; install and test instruments; inspect, check and troubleshoot aircraft navigation and communication systems. (C18-C20,F1,F5,F10)

III. INSTRUCTIONAL MATERIALS

A. The instructional materials identified for this course are viewable through www.ctcd.edu/books

January 2007
B. This text, Aircraft Inspection, Repair and Alterations: Acceptable Methods, Techniques and Practices, is located at the FAA website:


IV. COURSE REQUIREMENTS

The following will be required of each student for successful completion of this course:

A. Reading Assignment: Students are required to complete all reading assignments prior to the class in which the materials will be discussed. Students are subject to announced and unannounced written and oral examinations on assigned reading material.

B. Projects: The following projects will be completed by students only after coverage of the subjects listed below by course material and students having been given the opportunity to practice these tasks, will students be required to demonstrate proficiency and knowledge in these areas. (Projects are to be assigned based on instructor discretion and availability of resources.)

1. Remove and properly reinstall instruments from the panel of an aircraft.
2. Using an altimeter to find the existing barometric pressure, check a manifold pressure gage to determine whether or not its pointers are set correctly.
3. Explain the proper precautions that should be taken when removing a thermocouple-type cylinder head temperature indicator from an instrument panel.
4. Perform a static system check on an aircraft. Determine from the correct reference if the system meets the requirements for flight under Instrument Flight Rules.

C. Class performance: Students are required to attend all classes and to be in the classroom on time. The instructor can lower a student’s grade because of excessive tardiness. When absent from class for any reason, it is the student’s responsibility to arrange for and make up assignments missed during the absence.
D. Class Participation: Students will earn a satisfactory grade in the course by attending and regularly participating in class, giving complete attention to class activities, completion of all assigned work and successfully completing the examinations. Students are required to maintain a minimum GPA of 2.0 to receive a passing grade for the class and are encouraged to compute and monitor their GPA as the class progresses.

V. EXAMINATIONS

A. There will be three written examinations for this course covering all the lecture notes and reading material with a weight of 300 points each totaling 900 points.

B. Practicum: The instructor will select four hands-on projects in which students will be tested. Each hands-on test will carry a point weight of 25 points each, totaling 100 points.

VI. SEMESTER GRADE COMPUTATION

<table>
<thead>
<tr>
<th>EXAMINATIONS</th>
<th>POINTS</th>
<th>POINT TO GRADE RATIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXAM 1</td>
<td>300</td>
<td>900-1000 = A</td>
</tr>
<tr>
<td>EXAM 2</td>
<td>300</td>
<td>800- 899 = B</td>
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<tr>
<td>EXAM 3</td>
<td>300</td>
<td>700- 799 = C</td>
</tr>
<tr>
<td>Practicum/Projects 1-4</td>
<td>100</td>
<td>600- 699 = D</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1000</td>
<td>0- 599 = F</td>
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</table>

VII. NOTES AND ADDITIONAL INSTRUCTIONS FROM COURSE INSTRUCTOR

A. Course Withdrawal: It is the student’s responsibility to officially drop a class if circumstances prevent attendance. In order to be officially withdrawn from the course, a student must obtain, complete and file an Application for Withdrawal form with the College. The student’s transcript will show “W” or “F”, depending on whether the student was passing or failing at the time of withdrawal.

B. Administrative Withdrawal: Students not meeting course objectives or not making satisfactory progress may be withdrawn from the course at the discretion of the instructor.

C. Cellular Phones and Beepers: Cellular phones and beepers will be turned off while the student is in the classroom or laboratory.

D. American’s with Disabilities Act (ADA): Disability Support Services provide services to students who have appropriate documentation of a disability.
Students requiring accommodations for class are responsible for contacting the Office of Disability Support Services (DSS) located on the central campus. This service is available to all students, regardless of location. Explore the website at www.ctcd.edu/disability-support for further information. Reasonable accommodations will be given in accordance with the federal and state laws through the DSS office.

E. **Instructor Discretion:** The instructor reserves the right of final decision in course requirements.

F. **Civility:** Individuals are expected to be cognizant of what a constructive educational experience is and respectful of those participating in a learning environment. Failure to do so can result in disciplinary action up to and including expulsion.

VIII. COURSE OUTLINE

A. **Module One:** Aircraft Instruments

1. **Learning Outcomes:** Upon successful completion of this module, the Student will:

   Describe different classifications and purpose of aircraft instruments.

2. **Learning Activities:**

   Successfully complete examination 1 covering material presented in module 1. (F1,F5,F10)

3. **Equipment and Materials:**

   a. Static system checker

   b. Airframe with operational static system

4. **Module One Outline:** An Overview of Aircraft Instruments

   Classification of Aircraft Instruments
   1. Principles of Pressurization
   2. Pressure Measuring Instruments
      a) Absolute Pressure Instruments
      b) Gage Pressure Instruments
      c) Differential Pressure Instruments
3. Temperature Measuring Instruments
   a) Nonelectrical Temperature Measurements
   b) Electrical Temperature Measurements
      1) Resistance-Change Instruments
         (a) Wheatstone Bridge Circuits
         (b) Ratiometer Circuits
      2) Thermocouple Instruments

4. Mechanical Movement Measuring Instruments
   a) Position-Indicating Lights
   b) Synchro-Systems
      1) DC Selsyn System
      2) AC Magnesyn System
      3) AC Autosyn System
   c) Tachometers
      1) Mechanical Tachometer
      2) Electric Tachometer
   d) Synchroscopes
   e) Accelerometers
   f) Angle of Attack Indicating Systems

5. Direction-Indicating Instruments
   a) Compass Errors
      1) Variation
      2) Deviation
      3) Dip Errors
   b) Vertical-Card Magnetic Compass
   c) Flux Gate Compass System

6. Gyroscopic Instruments
   a) Attitude Indicator
   b) Heading Indicator

7. Rate Gyros
   a) Turn and Slip Indicator
   b) Turn Coordinator

B. Module Two: Aircraft Instrument Systems, Aural Warning Systems and Instrument Installation and Maintenance

1. Learning Outcomes: Upon successful completion of this module, the Student will:
   a. Describe different instruments associated with aircraft instrument systems.
   b. Describe automatic flight control systems.
   c. Describe aural warning systems.
d. Demonstrate properly handling, marking, installation and testing of aircraft instruments.

2. Learning Activities:

Successfully complete examination 2 covering material presented in module 2. (F1,F5,F10)

3. Equipment and Materials:

a. Static system checker

b. Airframe with operational static system.


a. Aircraft Instrument Systems
   1. Pitot-Static Systems
      a) Airspeed Indicators
         1) True Airspeed Indicator
         2) Maximum-Allowable Airspeed Indicator
      b) Machmeter
      c) Altimeters
         Encoding
      d) Vertical-Speed Indicators
         Instantaneous Vertical-Speed Indicator
   2. Gyro Instrument Power Systems
      Gyro Pneumatic Systems
      1) Suction Systems
         a) Wet Vacuum Pump System
         (b) Dry Air Pump Systems
      2) Pressure Systems
   3. Automatic Flight Control Systems
      a) Command Subsystem
      b) Error-Sensing Subsystem
      c) Correction Subsystem
      d) Follow-Up Subsystem
      e) Flight Director Indicator and Horizontal Situation Indicator
   b. Aural Warning Systems
   c. Instrument Installation and Maintenance
C. Module Three: Aircraft Communication and Navigation Systems

1. Learning Outcomes: Upon successful completion of this module, the Student will:
   
   a. Explain basic radio theory for AM, FM, SSB modulation, radio waves and antenna.
   
   b. Describe aircraft interphone systems.
   
   c. Explain the different types of aircraft navigation equipment utilized to determine direction, distance, position and weather mapping systems.
   
   d. Point out the electronic instrument systems used on aircraft which aid crew in the performance of their system management duties.
   
   e. Perform electronic instrument system installation and maintenance.

2. Learning Activities:
   
   a. Successfully complete examination 3 covering material presented in module 3. (F1,F5,F10)
   
   b. Complete projects: 1-4. (C18,F1,F5,F10)

3. Equipment and Materials:
   
   a. General mechanic hand tools, static system checker.
   
   b. Airframe with communication and navigational equipment properly installed with operators and maintenance manuals.

   
   a. Communication Systems
      1. Basic Radio Theory
a) Modulation
1) Amplitude Modulation (AM)
2) Frequency Modulation (FM)
3) Single-Sideband (SSB)
b) Radio Waves
1) Polarization
2) Wavelength
3) Frequency Allocation
4) Radio Wave Propagation
c) Antenna
1) Transmission Lines
2) Communication Radio Antenna
d) Aircraft Communication Addressing and Reporting System (ACARS)
e) Selective Calling (SELCAL)
f) Audio Integrating System (AIS)
1) Flight Interphone
2) Cabin Interphone
3) Service Interphone
4) Passenger Address
5) Passenger Entertainment
6) Ground Crew Call
7) Cockpit Voice Recorder
g) Emergency Locator Transmitter (ELT)

b. Electronic Navigation Systems
1. Automatic Direction Finder (ADF)
2. Very High Frequency Omnidirectional Range Navigation System (VOR)
   Radio Magnetic Indicator (RMI)
3. Instrument Landing System
   a) Compass Locators
   b) Localizer
   c) Marker Beacons
   d) Glide Slope
4. Radar Beacon Transponder
   Transponder Checks
5. Distance Measuring Equipment (DME)
6. Area Navigation (RNAV)
7. LORAN
8. Inertial Navigation System (INS)
9. Microwave Landing System (MLS)
10. Radar and Radio Altimeters
11. Ground Proximity Warning System (GPWS)
12. Traffic Alert Collision Avoidance System (TCAS)
13. Radar
a) Doppler Navigation Radar
b) Weather Radar

14. Stormscope Weather Mapping System
c. Electronic Instrument Systems
   1. Microcomputers
   2. Digital Indicating and Control Systems
      a) Electronic Flight Instrument Systems (EFIS)
      b) Engine Indicating and Crew Alerting System (EICAS)
      c) Electronic Centralized Aircraft Monitor System (ECAM)
   3. Air Data Computer
   4. Flight Management Computer System (FMCS)
d. Electronic Systems Installation and Maintenance
   1. Approval for the Installation of Electronic Equipment
   2. Electrical Considerations
      a) Load Limits
      b) Circuit Protection
      c) Wiring
         1) Bundling and Routing
         2) Transmission Lines
   3. Protection from Electrostatic Discharge and Damage
   4. Weight and Balance
   5. Cooling
   6. Shock Mounting
   7. Static Protection
   8. Antenna Installation
      a) Types of Antenna
         (1) VHF Communication
         (2) HF Communication
         (3) VOR/LOC
         (4) Glide Slope
         (5) Marker Beacons
         (6) ADF
         (7) DME
         (8) ATC Transponder
         (9) Radio Altimeter
         (10) ELT
      b) Antenna Structural Attachment