



**280-4C5-EM**  
**WINTER 2023**  
**Pre-Flight**

## COURSE OUTLINE

**COURSE:** Aircraft Instrumentation  
**PROGRAM:** 280.C0 Aircraft Maintenance Technology  
**DISCIPLINE:** 280 Aeronautics  
**WEIGHTING:** Theory: 3                      Practical Work: 2                      Personal Study: 2

**Teacher(s)**                      **Office**    ☎    **Extension**                      ✉    **e-mail or website**  
Mora Joaquin                      C-186                      4220                      [joaquin.mora@cegepmontpetit.ca](mailto:joaquin.mora@cegepmontpetit.ca)

### OFFICE HOURS

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Morning					
Afternoon					

**Coordinator(s)**                      **Office**    ☎    **extension**                      ✉    **e-mail or website**  
Paul Anthony Ashby                      C-160                      4225                      [paul-anthony.ashby@cegepmontpetit.ca](mailto:paul-anthony.ashby@cegepmontpetit.ca)  
Stéphanie Arpin                      C-160                      4630                      [stephanie.arpin@cegepmontpetit.ca](mailto:stephanie.arpin@cegepmontpetit.ca)

## 1- CONTEXT OF THIS COURSE IN THE PROGRAM

This course is offered during the fourth session of the program. It is intended for future Category M Aircraft Maintenance Engineers (AME). The objective is to enable them to diagnose and determine appropriate maintenance intervention for various aircraft instruments. In order to do this, they must know the terminology, their roles and operating principles. They must also be able to interpret the technical documentation provided by aircraft manufacturers.

This course presents a fairly complete overview of all types of instruments found onboard an aircraft.

**Students must keep this course outline for the duration of their studies as it will be useful for the comprehensive assessment at the end of the program.**

### Transport Canada

This course outline meets the requirements of Training Organisation Certification Manual (MCF) of Transport Canada.

The Department applies Transport Canada standard which allows a maximum absence of 5% for the course (theory and laboratory). The department compiles absences of all students enrolled in Aircraft Maintenance (280.C0) and Avionics (280.D0) according to Transport Canada requirements. The application of Transport Canada policies regarding absences is available on the college website and in the student agenda under the heading « Privilèges accordés par Transports Canada ».

## 2- COMPETENCIES OF THE EXIT PROFILE (STUDENT SKILL PROFILES)

Perform maintenance of aircraft systems.

## 3- MINISTERIAL OBJECTIVE(S) AND COMPETENCIES

**0263** Verify the operation of simple alternating-current circuits on an aircraft.  
**0265** Verify communications, navigation and instrumentation systems.

## 4- TERMINAL OBJECTIVE OF THE COURSE (FINAL COURSE OBJECTIVE)

At the end of the course, the student will be able to perform functional checks, recognize and diagnose any deviations from the standards established by the manufacturer and Transport Canada and certify the operation of a several navigation instruments.

## 5- TEACHING AND LEARNING STRATEGIES

### Theory

The theoretical part of the course "Aircraft Instruments" is organized into different themes covering most instruments found on aircrafts and their principal of operation.

Formal lectures, audio-visual support and short videos.

Laboratory

Students perform different instrumentation checks in teams of three or four.

- Weeks 1 and 2, the teacher will explain the basic instructions as well as the safety regulations.
- In the following weeks, students perform each laboratory activity in rotation until the first four labs are completed. The first exam will be held when the first four labs are completed.
- The same procedure will be repeated for next 4 laboratories, followed by a review on them.
- The exercises are performed using the course book and the manuals available in the laboratory.
- Laboratory manuals may include:
  - excerpts from CAR standards
  - extracts from aircraft maintenance manuals
  - extracts from component maintenance manuals
  - procedure manuals for the use of test equipment
- For each exercise, the student will have to complete the data sheets included in the laboratory notebook.
- The information entered by the student in his or her course book will serve as a study guide for both exams.

**6- COURSE PLAN**

**THEORY**

WEEK	LEANING OBJECTIVE	CONTENT	PERSONAL STUDIES ACTIVITIES
1	1- Distinguish and describe the elements and characteristics common to the instruments.	<ul style="list-style-type: none"> <li>▪ Presentation of the Course Outline</li> <li>▪ The elements of an instrument</li> <li>▪ The characteristics of an instrument</li> <li>▪ Types of errors</li> </ul> <p><b>TC Appendix C, part 2, 22.4.1, 22.4.2, 22.4.16</b></p>	Review study document and personal notes
2	2- Describe different methods of transmitting and displaying information.	<ul style="list-style-type: none"> <li>▪ Electro-mechanical and mechanical indicators</li> <li>▪ Liquid crystal alphanumeric or electroluminescent diode indicators</li> <li>▪ Cathode ray tubes (CRTs) and liquid crystal screens</li> <li>▪ Synchro transmitters</li> </ul> <p>Digital transmission line (digital ARINC Bus)</p>	Review study document and personal notes
3	3- Describe the role and operation of atmospheric reference instruments.  Recognize the requirements for maintaining navigability.	<ul style="list-style-type: none"> <li>▪ Atmosphere and atmosphere type</li> <li>▪ Pitot and static circuits</li> <li>▪ Altimeter</li> <li>▪ Vertical speed indicator</li> <li>▪ Pressurization control instruments</li> <li>▪ Anemometer, machmeter, excessive speed warning</li> <li>▪ Aerodynamic data computer</li> <li>▪ Applicable airworthiness standards</li> </ul> <p>Inspection, common maintenance, precautions</p>	Review study document and personal notes

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4	4- Describe the operation and role of basic magnetic and gyroscopic instruments.	<ul style="list-style-type: none"> <li>▪ Magnetic compass</li> <li>▪ Characteristics and properties of a gyroscope</li> <li>▪ Gyroscope training</li> <li>▪ Turn and side slope indicator and turn coordinator</li> <li>▪ Artificial horizon</li> <li>▪ Gyroscopic compass</li> <li>▪ Erector systems</li> <li>▪ Gyromagnetic compass</li> <li>▪ Introduction to the inertial navigation system</li> <li>▪ Gyrolaser</li> <li>▪ Applicable airworthiness standards</li> </ul> <p>Inspection, common maintenance, precautions</p>	Review study document and personal notes
6 and 7	5- Describe the role and operation of engine control and aircraft system instruments.	<ul style="list-style-type: none"> <li>▪ Temperature measurement</li> <li>▪ Pressure measurement</li> <li>▪ Quantity gauges</li> <li>▪ Tachometers</li> <li>▪ Synchroscope</li> <li>▪ Flowmeter</li> <li>▪ Torquemeter</li> <li>▪ Engine pressure ratio</li> <li>▪ Vibration measurement</li> <li>▪ Angle of attack measurement</li> </ul> <p>Stall protection system</p>	Review study document and personal notes
8 and 9	6- Describe the role, architecture and operation of a centralized failure management system.	<ul style="list-style-type: none"> <li>▪ An example of architecture</li> <li>▪ EICAS (Engine indicating &amp; crew alerting system) or ECAM (Electronic centralized aircraft monitoring)</li> </ul> <p>Maintenance diagnostic system</p>	Review study document and personal notes
11 to 13	7- Describe the role and operation of navigation instruments.	<ul style="list-style-type: none"> <li>▪ ADF</li> <li>▪ VOR</li> <li>▪ DME</li> <li>▪ ILS</li> <li>▪ Radio altimeter</li> <li>▪ INS</li> <li>▪ GPS</li> <li>▪ ATC transponder</li> <li>▪ Collision avoidance system (TCAS)</li> <li>▪ Ground proximity warning system (GPWS)</li> </ul> <p>Weather radar</p>	Review study document and personal notes
14	8- Describe the operation of the:  - autopilot and flight director systems. - flight management system. - flight recorders.	<ul style="list-style-type: none"> <li>▪ Architecture of an autopilot system</li> <li>▪ Basic and higher functions</li> <li>▪ Auto-throttle</li> <li>▪ Flight director</li> </ul> <ul style="list-style-type: none"> <li>▪ Introduction to flight management system (FMS)</li> </ul> <ul style="list-style-type: none"> <li>▪ Flight data acquisition recording system (FDARS)</li> <li>▪ Flight data acquisition unit (FDAU)</li> <li>▪ Flight data recorder (FDR)</li> <li>▪ Quick access recorder (QAR)</li> <li>▪ Cockpit voice recorder (CVR)</li> </ul>	Review study document and personal notes

**PRACTICAL WORK (LABORATORY)**

WEEK	LEARNING OBJECTIVE	CONTENT	PERSONAL STUDIES ACTIVITIES
1 and 2	<p>Concepts and principles of operation of instruments and test equipment.</p> <p>Performing the work in accordance with safety rules and operating procedures of the laboratory equipment.</p>	<ul style="list-style-type: none"> <li>▪ Presentation of course outline.</li> <li>▪ Demonstration of various test benches.</li> <li>▪ Descriptions of tests to be carried out during the course.</li> </ul> <p>Procedures and precautions.</p>	<p>Prior reading of the laboratory documents.</p>
3 to 6	<p><b>1- Perform tests on a CHT indicator (Cylinder Head Temperature)</b></p> <ul style="list-style-type: none"> <li>- Identify compliance standards and appropriate procedures.</li> <li>- Use appropriate testing equipment.</li> <li>- Compare the data for each test to ensure compliance with the standards of manufacturers, and CARs.</li> <li>- Meticulously record test results.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Test bench specification.</li> <li>▪ Calibration of test equipment.</li> <li>▪ Tolerances.</li> <li>▪ Tests to run scale error, friction error, hysteresis error.</li> <li>▪ Description of the test equipment: components, operation.</li> </ul> <p>Description of the CHT: components, operation.</p>	<p>Prior reading of the laboratory documents.</p>
	<p><b>2- Perform tests on a manometer (Dead weight test)</b></p> <ul style="list-style-type: none"> <li>- Identify compliance standards and appropriate procedures.</li> <li>- Use appropriate testing equipment.</li> <li>- Compare the data for each test to ensure compliance with the standards of manufacturers, builders and CARs.</li> <li>- Meticulously record test results.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Test bench specification.</li> <li>▪ Calibration of test equipment.</li> <li>▪ Tolerances.</li> <li>▪ Tests to run scale error, friction error, hysteresis error.</li> <li>▪ Description of the test equipment: components, operation.</li> <li>▪ Description of the tachometer: components, operation.</li> </ul>	<p>Complete data sheets.</p>
	<p><b>3- Perform checks on an Altimeter.</b></p> <ul style="list-style-type: none"> <li>- Identify compliance standards and appropriate procedures.</li> <li>- Use appropriate testing equipment.</li> <li>- Compare data obtained for each check in order to comply with the manufacturer and CAR's standards.</li> <li>- Meticulously record test results.</li> </ul>	<ul style="list-style-type: none"> <li>▪ CAR standards.</li> <li>▪ Component's manuals.</li> <li>▪ Manufacturer's test bench procedure.</li> <li>▪ Calibrating test equipment.</li> <li>▪ Frequency of performing tests.</li> <li>▪ Test points to simulate.</li> <li>▪ Tolerances.</li> <li>▪ Scale error, hysteresis error, persistence, friction error, case sealing, barometric scale error.</li> <li>▪ Description of testing equipment; digital barometer, vacuum chamber, vacuum pump.</li> </ul> <p>Description of barometric altimeter; ID plate, components, operation.</p>	<p>Prior reading of the laboratory documents.</p> <p>Complete data sheets.</p>
	<p><b>4- Perform checks on a Turn and Bank indicator.</b></p>	<ul style="list-style-type: none"> <li>▪ Manufacturer's specifications</li> <li>▪ Calibrating test equipment</li> </ul>	<p>Prior reading of the laboratory</p>

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	<ul style="list-style-type: none"> <li>- Identify compliance standards and appropriate procedures.</li> <li>- Use appropriate testing equipment.</li> <li>- Compare data obtained for each check in order to comply with the manufacturer and CAR's standards.</li> <li>- Meticulously record the results of the tests performed.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Tests: check inclinometer, needle</li> <li>▪ Tolerances</li> <li>▪ Description of testing equipment: power source, turntable, strobe light</li> <li>Description of turn and side slope turn indicator: ID plate, components, operation</li> </ul>	<p>documents.</p> <p>Complete data sheets.</p>
8 to 11	<p><b>5- Perform checks on a Directional Gyro</b></p> <ul style="list-style-type: none"> <li>- Identify compliance standards and appropriate procedures.</li> <li>- Use appropriate testing equipment</li> <li>- Compare the data for each check to comply with CAR and the manufacturer's standards.</li> <li>- Meticulously record results from the checks performed.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Manufacturer's specifications.</li> <li>▪ Calibration of test equipment.</li> <li>▪ Tests: free rotation of the rotor, rotor speed, drift, erector mechanism, locking mechanism, starting the rotor, housing seal, flow.</li> <li>▪ Tolerances.</li> <li>▪ Description of the testing equipment: pneumatic power source, Scorsby table.</li> <li>Description of the directional indicator: ID plate, components, operation.</li> </ul>	<p>Prior reading of the laboratory documents.</p> <p>Complete data sheets.</p>
	<p><b>6- Perform checks on a Tachometer.</b></p> <ul style="list-style-type: none"> <li>- Identify compliance standards and appropriate procedures.</li> <li>- Use appropriate testing equipment.</li> <li>- Compare the data for each check to ensure compliance with the standards of the manufacturer's builders and CARs.</li> <li>- Meticulously record the results of the checks performed.</li> </ul>	<ul style="list-style-type: none"> <li>▪ CAR standards.</li> <li>▪ Test bench specification.</li> <li>▪ Calibration of test equipment.</li> <li>▪ Tolerances.</li> <li>▪ Tests to run: scale error, friction error, hysteresis error.</li> <li>▪ Description of the test equipment: components, operation.</li> <li>Description of the tachometer: components, operation.</li> </ul>	<p>Prior reading of the laboratory documents.</p> <p>Complete data sheets.</p>
	<p><b>7- Perform tests with the magnetic compass.</b></p> <ul style="list-style-type: none"> <li>- Identify compliance standards and appropriate procedures.</li> <li>- Use appropriate testing equipment.</li> <li>- Compare the data for each test to ensure compliance with the standards of manufacturers, builders and CARS.</li> <li>- Meticulously record test results.</li> </ul>	<ul style="list-style-type: none"> <li>▪ RAC standards.</li> <li>▪ Running procedure.</li> <li>▪ Calibration of test equipment.</li> <li>▪ Run frequency, test points to simulate, tolerances.</li> <li>▪ Tests to run liquid, compensation mechanism, friction, magnet neutralisation, compensation chart.</li> <li>▪ Description of the master compass: components, operation.</li> <li>▪ Description of the magnetic compass: components, operation.</li> </ul>	<p>Prior reading of the laboratory documents.</p> <p>Complete data sheets.</p>
	<p><b>8- Perform checks on pitot-static circuits.</b></p> <p>Identify compliance standards and appropriate procedures.</p> <ul style="list-style-type: none"> <li>- Use appropriate testing equipment.</li> <li>- Compare data obtained for each</li> </ul>	<ul style="list-style-type: none"> <li>▪ Excerpts of CAR standards. Leak test (CAR 571), calibration test (CAR 605/625).</li> <li>▪ Excerpts from aircraft maintenance manuals (where applicable).</li> <li>▪ Component's manuals.</li> <li>▪ Procedures of manufacturer's test bench.</li> <li>▪ Calibrating test equipment.</li> </ul>	<p>Prior reading of the laboratory documents.</p> <p>Complete data sheets.</p>

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	check in order to comply with CAR and manufacturer's standards. - Meticulously record test results.	<ul style="list-style-type: none"> <li>▪ Frequency of performing tests.</li> <li>▪ Test points to simulate.</li> <li>▪ Tolerances.</li> <li>▪ Description of testing equipment: components and operation principle.</li> <li>▪ Description of pitot-static circuit: components and operation principle.</li> </ul>	
12 to 14	<b>9- Troubleshooting connected to the pitot-static system on an aircraft.</b>  - Perform system testing of protection against the frost of pitot-static circuits.  (Aircraft to be advised)	<ul style="list-style-type: none"> <li>▪ Aircraft maintenance manual (AMM).</li> <li>▪ Manufacturer's parts manuals (IPC).</li> <li>▪ Locations of components on available aircraft.</li> <li>▪ Checklists. Precautions.</li> </ul>	<p>Prior reading of the laboratory documents.</p> <p>Complete data sheets.</p>

**7- SYNTHESIS OF SUMMATIVE EVALUATION METHODS**

**Theory**

Description of evaluation activity	Context	Learning objective(s)	Due date (actual date will be posted on LÉA)	Weighting (%)
Exam 1 on material from weeks 1 to 4	Individually. Multiple choice and short answer exam No notes allowed	1, 2, 3, 4.	Weeks 5	20%
Exam 2 on material from weeks 6 to 9	Individually. Multiple choice and short answer exam No notes allowed	5, 6.	Weeks 10	20%
Exam 3 on material from weeks 11 to 14	Individually. Multiple choice and short answer exam No notes allowed	7, 8.	Weeks 15	20%

**Sub-total: 60%**

**Laboratory**

Description of evaluation activity	Context	Learning objective(s)	Due date (approximate date assignment due or exam given)	Weighting (%)
Written exam short answer (Open book)	Individual	Labs 1 to 4	Week 6	20%
Written exam short answer (Open book)	Individual	Labs 5 to 8 and supplemental activities	Week 14	20%

**Sub-total: 40%**

**TOTAL: 100%**

## 8- REQUIRED MATERIAL

Theory classes: a paper copy of the study document (available on LÉA) is recommended but not mandatory. Students that prefer to take class notes on a laptop can do so but no cellphone will be allowed in class.

Laboratory: In the lab, safety glasses, safety shoes and overalls (or approved ÉNA work clothes) are mandatory. Students not complying with this rule will not be admitted in the laboratory.

Paper copy of the lab documents is necessary to take valuable notes as lab exams are open book (and students can only use their own notes at the exam).

## 9- MEDIAGRAPHY

- Aviation Technician Training Series, Avionics Fundamentals, Éditeur I.A.P. 1987.  
CRANE Dale, Aircraft Instruments Systems, Éditeur Aviation Maintenance Publishers Inc.  
629.135 C 891a
- Orford Air Training School, Navigation aérienne, Les aides radio, Éditeur Modulo. P 629.1351 098 r 4Fq  
Oxford Air Training School, Navigation aérienne, Instruments de bord, Québec, Ministère de l'éducation,  
SGME 1981. 629.1352 098 i Fq.
- PALLETT EHJ, Automatic Flight Control, Éditeur Granada, Toronto, 1983. 629.1352 p 166 1983  
PALLETT EHJ, Aircraft Instruments, Éditeur Pitman Publishing Limited, 629.135 p 1662 Édition 1972-79,  
629.135 p 1662 Édition 1981.
- PALLETT EHJ, Aircraft Instruments and Integrated System, édition Longman Scientific & Technical,  
1992.629.135 P 166 ai
- POWELL J, Aircraft Radio Systems, Éditeur Pitman Publishing Limited, 1981. 629.135 p 8843
- Transports Canada, Règlement de l'aviation canadien (RAC 523, 525, 571, 605-625
- Jeppesen, Avionics Fundamentals. Éditeur : Sanderson Training Products. 629.135A958

## 10- REQUIREMENTS TO PASS THE COURSE

### (1) Passing Mark

The passing mark for this course is 60%.

### (2) Attendance for Summative Evaluations

Students must be present for summative evaluations.

### (3) Submitting Assignments

All assignments must be submitted by the date, hour and location designated by the instructor(s). Late assignments will be penalized in the following manner:

### (4) Presentation of Written Work

Students must follow the standards adopted by the Cégep for written work (« *Normes de présentation matérielle des travaux écrits* »). These can be found in the documentation centre on the Cégep web site <http://ena.cegepmontpetit.ca/liens-eclair> under the heading **Liens éclair**, **Bibliothèques**, « Aide ».



## 11- METHODS OF COURSE PARTICIPATION

### For bimodal classes (if necessary due to public health requirements):

By attending online classes through videoconference technology, the student understands that his image and voice may be captured on video in the context of his courses and agrees to this. Videos are only visible during live classes and by the teacher and other participants exclusively.

For pedagogical reasons, some courses may be recorded. It is the teacher's responsibility to clearly inform students beforehand when their images and voices are to be captured on video. Any student opposed to his image and/or voice being recorded may turn off his camera and microphone but will be required to participate in writing through means established by the teacher. Otherwise, students who activate their cameras or their microphones are deemed to have agreed to their images and voices being taped. These recordings of courses will be available for the express and sole use of those students registered in the courses for the duration of the semester. It is strictly forbidden to broadcast these recordings in any public manner or to use them other than for pedagogical purposes.

No student may record an online course without prior consent from the teacher. Students whose personal information (voices and images) is captured on video may exercise such remedies as provided by the right to access records and the right of rectification per the Act respecting access to documents held by public bodies and the protection of personal information through the Cegep's Secretary General's Office.

## 12- OTHER DEPARTMENTAL REGULATIONS

Students are encouraged to consult the website for the specific regulations for this course:

<http://guideena-en.cegepmontpetit.ca/departement-rules/>

<https://mareussite.cegepmontpetit.ca/ena/mon-parcours/mon-programme/regles-departementales>

## 13- INSTITUTIONAL POLICIES AND REGULATIONS

All students enrolled at Cégep Édouard-Montpetit must become familiar with and comply with the institutional policies and regulations. In particular, these policies address learning evaluations, maintaining admission status, French language policies, maintaining a violence-free and harassment-free environment, and procedures regarding student complaints. The French titles for the policies are: *Politique institutionnelle d'évaluation des apprentissages* (PIEA), la *Politique institutionnelle de la langue française* (PILF), la *Politique pour un milieu d'études et de travail exempt de harcèlement et de violence* (PPMÉTEHV), les *Conditions d'admission et cheminement scolaire*, la *Procédure concernant le traitement des plaintes étudiantes dans le cadre des relations pédagogiques*.

The full text of these policies and regulations is accessible on the Cégep web site at the following address:

<http://www.cegepmontpetit.ca/ena/a-propos-de-l-ecole/reglements-et-politiques>. If there is a disparity between shortened versions of the text and the full text, the full text will be applied and will be considered the official version for legal purposes.

## 14- STUDENT ACCESSIBILITY CENTER - FOR STUDENTS WITH DISABILITIES

Students having received a professional diagnosis of impairment (motor skills, neurological, organic, sensory, learning difficulties, mental health, autism spectrum disorder or other) or suffering from a temporary medical condition may request special accommodations.

Students seeking these accommodations must forward their diagnosis to the CSA by either MIO to "Service, CSA-ENA" or email to "servicesadaptesena@cegepmontpetit.ca".

Students already registered with the CSA must communicate with their teachers at the beginning of the semester to discuss those accommodations they have been awarded by the CSA.

## 15- ANNEX

None