

## COURSE OUTLINE

**COURSE:** Maintenance of Aircraft Flight Controls and Control Surfaces

**PROGRAM:** 280.C0 Aircraft Maintenance Technology

**DISCIPLINE:** 280 Aeronautics

**WEIGHTING:** Theory: 2                      Practical Work: 3                      Personal Study : 1

Instructor(s)	Office	☎ Extension	✉ Email or Website
Stéphane Caron	C-182	4687	<a href="mailto:stephane.caron@cegepmontpetit.ca">stephane.caron@cegepmontpetit.ca</a>

### OFFICE HOURS

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Morning					
Afternoon					

Coordinator(s)	Office	☎ Extension	✉ Email or Website
Dany Charette	B-125	4661	<a href="mailto:dany.charette@cegepmontpetit.ca">dany.charette@cegepmontpetit.ca</a>
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## CONTEXT OF THIS COURSE IN THE PROGRAM

This course is offered during the fifth session of the Aircraft Maintenance Program.

The *Maintenance of Aircraft Flight Controls and Control Surfaces* course prepares students for the general maintenance techniques of aircraft flight controls and control surfaces.

The objectives of this course, together with the prerequisite course, "Introduction to Aeronautics," provide students with the theoretical and practical skills they will need for their final courses on airplane and helicopter internships for aircraft maintenance technicians.

As in all sectors, basic knowledge of aircraft flight controls and control surfaces is essential in order to understand more complex systems and provide effective maintenance. The vast majority of aircraft currently in service follow the basic principles demonstrated in this course.

Upon completion of this course, students will have developed the ability to:

- gather necessary information;
- plan work;
- perform activities related to inspecting and checking flight controls;
- adjust the flight control system on an airplanes and helicopters;
- perform activities related to repairing a control surface;
- perform activities related to the repair of components of flight control;
- store material appropriately and clean the work place.

**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 ».

## MINISTRY OBJECTIVE(S) AND COMPETENCIES

**0267** To maintain flight controls and flight control surfaces.

## TEACHING AND LEARNING STRATEGIES

**Theory:** First, students will acquire the concepts necessary to carry out the work in the laboratory. Next, emphasis will be placed on the engineering aspect of aircraft controls and control surfaces using oral presentations, discussions and problem solving. Understanding the relationship between the controls and the control surfaces is at the heart of this course. At the end of the course, students will use a problem-solving method through case studies and identify the common problems encountered while servicing control circuits and control surfaces.

The course manual provides students with a guide to promote a better understanding of the theory part of the course. In addition to this, students can consult the internet site for this course and documents posted on LÉA. These resources provide students with answers to questions when working at home.

**Practical Work:** During the laboratory sessions, the instructor will guide students by using practical demonstrations and provide technical assistance and advice to foster a spirit of research, analysis and synthesis.

It is the responsibility of each student to be involved in the laboratories by following all of the given instructions. The activities listed must be completed by each team member.

COURSE PLAN – THEORY

**Block 1: Manuals, Hardware, Tools, Tasks (6 hours)**

<b>Learning Objectives</b>	<b>Content</b>	<b>Personal Study Activities</b>
Identify the sources of information applicable to work on aircraft controls and control surfaces.	<ul style="list-style-type: none"> <li>▪ manufacturer’s manuals</li> <li>▪ hardware catalogue</li> <li>▪ official publications</li> <li>▪ logbooks</li> </ul>	<p>Consult the internet site for 280-5A5 and documents posted in LÉA</p> <p>Consult the recommended readings.</p> <p>Review personal notes.</p>
Identify the hardware used in control system and control surfaces.	<ul style="list-style-type: none"> <li>▪ AN, MS, NAS coding</li> </ul>	
Describe tools according to the work to be performed.	<ul style="list-style-type: none"> <li>▪ linear and angular measuring tools</li> <li>▪ inclinometer</li> <li>▪ tensiometer, mechanical tools</li> <li>▪ crimping tools</li> </ul>	
Describe applicable maintenance tasks.	<ul style="list-style-type: none"> <li>▪ installation</li> <li>▪ removal</li> <li>▪ mounting</li> <li>▪ disassembly</li> <li>▪ adjustment</li> <li>▪ repair</li> <li>▪ replacement</li> <li>▪ inspection</li> <li>▪ balancing</li> </ul>	

**ACTIVITY PERIODS (week order is subject to be modify)**

<b>Week</b>	<b>No. hours</b>	<b>Content of Theory Course</b>
1	2	Review and preparation
2	2	Airworthiness Notice C010, maintenance tasks
3	2	Identify the hardware and Inspection rules

**Block 2: Control Links “and” Control Surfaces (16 hours)**

Learning Objectives	Content	Personal Study Activities
Identify the controls and control surfaces of an aircraft and their interrelationships.	<ul style="list-style-type: none"> <li>▪ Ailerons, rudder, elevator, tabs (speed and evolution), flaps (high-lift device, hyposustentateurs, airbrakes), airplane controls, helicopter controls, automatic pilot, other mechanisms</li> </ul>	<p>Consult the internet site for 280-5A5 and documents posted in LÉA</p> <p>Consult the recommended readings.</p> <p>Review personal notes.</p>
Identify the linkages between the controls and the control surfaces.	<ul style="list-style-type: none"> <li>▪ mechanics</li> <li>▪ hydromechanics</li> <li>▪ electromechanics</li> <li>▪ electro-hydromechanics</li> </ul>	
Explain the aerodynamic effect of the movement of the control surfaces on the aircraft.	<ul style="list-style-type: none"> <li>▪ lift</li> <li>▪ pressure coefficient</li> <li>▪ aerodynamic moment</li> </ul>	
Explain the aerodynamic effect of the movement of the control surfaces on the linkages.	<ul style="list-style-type: none"> <li>▪ hinge moment</li> <li>▪ fluttering</li> </ul>	
Apply simple machine concepts to the study of the the control systems and the control surfaces.	<ul style="list-style-type: none"> <li>▪ calculating the hinge moment</li> <li>▪ forces in the tubes and cables</li> <li>▪ piloting forces</li> <li>▪ material constraints</li> </ul>	
Explain the operation of various elements of a flight control circuit.	<ul style="list-style-type: none"> <li>▪ simple circuit</li> <li>▪ modern circuit</li> <li>▪ centering spring</li> <li>▪ displacement modifier</li> <li>▪ tension regulator</li> <li>▪ stall warning system</li> <li>▪ overload limiter</li> <li>▪ control blocker</li> <li>▪ anti-burst</li> <li>▪ automatic pilot linkages</li> <li>▪ redundancy, reliability</li> </ul>	

**ACTIVITY PERIODS (week order is subject to be modify)**

Week	No. hours	Content of Theory Course
4	2	Aerodynamics and the hinge moment
5	2	Mechanical physics, simple machines, forces in tubes, cables
<b>6</b>	<b>2</b>	<b>Exam No 1</b>
7 & 8	6	Mechanical circuits
9	2	Hydraulic circuits
10 & 11	2	Dornier vs Challenger, distinction and comprehension of different circuits

**Block 3: Maintenance of Aircraft Controls and Control Surfaces (8 hours)**

Learning Objectives	Content	Personal Study Activities
Determine the actions to be taken based on the nature of the work to be done.	<ul style="list-style-type: none"> <li>▪ Steps:                             <ul style="list-style-type: none"> <li>- locate relevant information in a maintenance manual and other publications</li> <li>- confirm the technical problem</li> <li>- compare the inspection results with the technical information</li> <li>- use technical documentation to clarify the solution to the technical problem</li> </ul> </li> </ul>	<p>Consult the internet site for 280-505 and documents posted in LÉA</p> <p>Consult the recommended readings.</p> <p>Review personal notes.</p>
Organize the actions to be taken based on the nature of the work to be done.	<ul style="list-style-type: none"> <li>▪ Find applicable procedures in an aircraft maintenance manual for:                             <ul style="list-style-type: none"> <li>- installation</li> <li>- removal</li> <li>- mounting</li> <li>- disassembly</li> <li>- adjustment</li> <li>- repair</li> <li>- replacement</li> <li>- inspection</li> <li>- balancing</li> </ul> </li> <li>▪ Determine the parts, the hardware and the support equipment needed to carry out the work</li> <li>▪ Organize the work area:                             <ul style="list-style-type: none"> <li>- rigor</li> <li>- communication</li> <li>- cleanliness</li> <li>- health and safety</li> </ul> </li> </ul>	

**ACTIVITY PERIODS (week order is subject to be modify)**

Week	No. hours	Content of Theory Course
12	2	Troubleshooting / Problem-Solving
13	2	ATA procedure redaction activities
14	2	Electrical circuits
15	2	<b>Exam 2</b>

COURSE PLAN – PRACTICAL WORK

THE FOLLOWING OBJECTIVES APPLY AND WILL BE PART OF THE EVALUATION CRITERIA FOR ALL ACTIVITIES IN THE LABORATORY AND HANGARS

Learning Objectives	Content	Personal Study Activities
Choose the actions to be taken based on the work to be done.	<ul style="list-style-type: none"> <li>▪ Steps:                             <ul style="list-style-type: none"> <li>- locate relevant information in a maintenance manual and other publications</li> <li>- confirm the technical problem</li> <li>- compare the inspection results with the technical information</li> <li>- use technical documentation to clarify the solution to the technical problem</li> </ul> </li> </ul>	All activities aimed at improving manual dexterity.
Organize the actions to be taken based on the nature of the work to be done.	<ul style="list-style-type: none"> <li>▪ Find applicable procedures in an aircraft maintenance manual for:                             <ul style="list-style-type: none"> <li>- installation</li> <li>- removal</li> <li>- mounting</li> <li>- disassembly</li> <li>- adjustment</li> <li>- repair</li> <li>- replacement</li> <li>- inspection</li> <li>- balancing</li> </ul> </li> <li>▪ Determine the parts, the hardware and the support equipment needed to carry out the work</li> <li>▪ Organize the work area:                             <ul style="list-style-type: none"> <li>- rigor</li> <li>- communication</li> <li>- cleanliness</li> </ul> </li> <li>▪ - health and safety</li> </ul>	
Apply the health and safety standards that relate to the work to be done.	<ul style="list-style-type: none"> <li>▪ Comply with standards and guidelines</li> </ul>	
Comply with the standards for hazardous materials.	<ul style="list-style-type: none"> <li>▪ Using the information system for hazardous materials at work (WHMIS)</li> <li>▪ Using material safety data sheet and taking precautions in handling</li> </ul>	
Store tools and equipment appropriately.	<ul style="list-style-type: none"> <li>▪ Following instructions</li> </ul>	
Clean the work area.	<ul style="list-style-type: none"> <li>▪ Following instructions</li> </ul>	

**Block 1: Manuals, Hardware, Tools, Terminology (12 hours)**

<b>Learning Objectives</b>	<b>Content</b>	<b>Personal Study Activities</b>
Identify the source of applicable information for the work on aircraft controls and control surfaces.	<ul style="list-style-type: none"> <li>▪ Manufacturer's manuals</li> <li>▪ Hardware catalogue</li> <li>▪ Official publications</li> <li>▪ Logbooks</li> </ul>	<p>All activities aimed at improving manual dexterity.</p> <p>Consult the recommended readings.</p> <p>Review personal notes.</p>
Identify the hardware used in the control circuits and control surfaces.	<ul style="list-style-type: none"> <li>▪ Specific AN, MS, NAS coding</li> </ul>	
Describe the tools based on the work to be done.	<ul style="list-style-type: none"> <li>▪ linear and angular measuring tools</li> <li>▪ inclinometer</li> <li>▪ tensiometer, mechanical tools</li> <li>▪ crimping tools</li> </ul>	
Identify the aircraft controls and control surfaces and their interrelationships.	<ul style="list-style-type: none"> <li>▪ Ailerons, rudder, elevator, tabs (speed and evolution), flaps (high-lift device, hyposustentateurs, airbrakes), airplane controls, helicopter controls, automatic pilot, other mechanisms</li> </ul>	

**ACTIVITY PERIODS (week order is subject to be modify)**

<b>Week</b>	<b>No. hours</b>	<b>Content of Practical Course</b>
1	3	Introduction to the course, teaching module
2	3	Maintenance Manual & IPC, Observation, aircraft circuit diagram
3	3	Flight control maintenance special tools
4	3	Cables manufacturing

**Block 2: Inspection and Maintenance Tasks (15 hours)**

Learning Objectives	Content	Personal Study Activities
Describe applicable maintenance tasks.	<ul style="list-style-type: none"> <li>▪ installation</li> <li>▪ removal</li> <li>▪ mounting</li> <li>▪ disassembly</li> <li>▪ adjustment</li> <li>▪ repair</li> <li>▪ replacement</li> <li>▪ inspection</li> <li>▪ balancing</li> </ul>	All activities aimed at improving manual dexterity.
Perform an inspection of a flight control system.	Steps: <ul style="list-style-type: none"> <li>- identifier the different qualitative and standard inspection methods</li> <li>- check compliance with the flight circuit control and the relevant technical information</li> <li>- identify and record defects observed on the flight control circuit</li> <li>- prepare an inspection report</li> </ul>	

**ACTIVITY PERIODS (week order is subject to be modify)**

Week	No. hours	Content of the Practical Course
5 & 6	3	Assembly, adjustments and safety
7	3	<b>Exam 1</b>
8	3	Static balancing and Inspection techniques
9	3	Inspection activities

**Block 3: Manual, Hydraulic and Electrical Circuits (3 hours)**

Learning Objectives	Content	Personal Study Activities
Identify the linkages between the controls and the control surfaces.	<ul style="list-style-type: none"> <li>▪ Mechanics</li> <li>▪ Hydromechanics</li> <li>▪ Electromechanics</li> <li>▪ Electro-hydromechanics</li> </ul>	

**ACTIVITY PERIODS (week order is subject to be modify)**

Week	No. hours	Content of Practical Course
10	3	Challenger 601 Cockpit operation and functional check



**Block 4: Maintenance of Controls and Control Surfaces (15 hours)**

Learning Objectives	Content	Personal Study Activities
Perform the rigging of a flight control system on an airplane and on a helicopter.	<ul style="list-style-type: none"> <li>• Researching applicable procedure in the aircraft maintenance manual</li> <li>• Follow-up with adjustment procedure</li> <li>• Using various required tools for adjusting</li> <li>• Securing and locking fasteners and connectors</li> <li>• Compliance with regulatory requirements regarding work on controls and control surfaces</li> <li>• Writing a work report</li> </ul>	<p>All activities aimed at improving manual dexterity.</p> <p>Consult the recommended readings.</p> <p>Review personal notes.</p>
Perform a repair on an aircraft control surface.	<ul style="list-style-type: none"> <li>• <b>Situation Analysis:</b> <ul style="list-style-type: none"> <li>o identify the facts</li> <li>o locate relevant information</li> <li>o recognize health and safety risks and dangers</li> </ul> </li> <li>• <b>Choosing a Solution</b> <ul style="list-style-type: none"> <li>o be aware of normal operation</li> <li>o check compliance of the flight control surface with relevant technical information</li> <li>o isolate the cause of the technical problem</li> <li>o determine the action to take</li> <li>o make the repair</li> <li>o replace as necessary</li> <li>o make adjustments</li> </ul> </li> <li>• <b>Organisation of the Action</b> <ul style="list-style-type: none"> <li>o Locate relevant aircraft procedures in an aircraft maintenance manual for                             <ul style="list-style-type: none"> <li>-installation</li> <li>-removal</li> <li>-disassembly</li> <li>-adjustment</li> <li>-repair</li> <li>-replacement</li> </ul> </li> <li>o Determine the parts, the hardware and the support equipment needed for the work to be done</li> <li>o -organize the work area</li> <li>o -carry out work in teams</li> <li>o -secure and lock fasteners and connectors</li> </ul> </li> <li>• <b>Monitor the Results</b> <ul style="list-style-type: none"> <li>o -comply with regulatory requirements concerning work on aircraft controls and control surfaces</li> <li>o -check compliance of flight control surface with relevant technical information</li> <li>o -write a work report</li> </ul> </li> </ul>	
Perform a repair on an element of the linkage between an aircraft control and the control surface.	<ul style="list-style-type: none"> <li>o -disassembly</li> <li>o -adjustment</li> <li>o -repair</li> <li>o -replacement</li> <li>o Determine the parts, the hardware and the support equipment needed for the work to be done</li> <li>o -organize the work area</li> <li>o -carry out work in teams</li> <li>o -secure and lock fasteners and connectors</li> <li>• <b>Monitor the Results</b> <ul style="list-style-type: none"> <li>o -comply with regulatory requirements concerning work on aircraft controls and control surfaces</li> <li>o -check compliance of flight control surface with relevant technical information</li> <li>o -write a work report</li> </ul> </li> </ul>	

**ACTIVITY PERIODS (week order is subject to be modify)**

Week	No. hours	Content of Practical Course
11	3	Work on aircraft
12	3	Work on aircraft
13	3	Work on aircraft
14	3	Work on aircraft
15	3	<b>Exam 2</b>

SYNTHESIS OF SUMMATIVE EVALUATION METHODS: THEORY

Description of Evaluation Activity	Further Study of One of the Aspects of the Course	Learning Objective(s)	Due Date (approximate date assignment due or exam given)	Weighting (%)
Exam 1	Individual	Bloc 1 theo → 1.1.,1.2 Bloc 2 theo→ 2.3, 2.4, 2.5, 2.6	Week 6	10
Integration of course subjects Challenger vs Dornier	Individual / team (depending on the evaluation grid)	Bloc 1, 2 et 3 theo → 1.3, 1.4 2.1, 2.2, 2.6 3.1, 3.2	Week 10-11	10
ATA procedure redaction	Individual	Bloc 1, 2 et 3 theo → 1.3, 1.4 2.1, 2.2, 2.6 3.1, 3.2	Week 13	5
Exam 2	Individual	Blocks 2 and 3 Theory	Week 15	15

**TOTAL : 40%**

SYNTHESIS OF SUMMATIVE EVALUATION METHODS: PRACTICAL WORK

Description of Evaluation Activity	Context	Learning Objective(s)	Due Date (approximate date assignment due or exam given)	Weighting (%)
Diagram of a control circuit and control surfaces	Individual	Block 1, Practical Work	Week 4	5
Written and practical inspection (check) Exam 1	Individual. The exam includes a theory part, research and a practical part.	Blocks 1 and 2, Practical Work	Week 7	15
Report of maintenance activities	Written report in teams, individual observations (depending on the evaluation grid)	Blocks 2, 3 and 4, Practical Work	Week 4 to14	15
Written and practical inspection (check) Exam 2	Individual. The exam includes a theory part, research and a practical part.	Blocks 2, 3 and 4, Practical Work	Week 15	25

**TOTAL : 60%**

## REQUIREMENTS TO PASS THE COURSE

### (1) Passing Mark

The passing mark for this course is 60%.

### (2) Attendance for Summative Evaluations

Attendance at summative evaluation activities is mandatory.

### (3) Submitting Assignments

Assignments must be submitted by the date, place and time determined by the instructor. Any assignment submitted after the due date will be penalized 10% per day for each day it is late up to a week. After one week, the assignment will receive a zero (0).

### (4) Presentation of Written Work

Students must follow the standards adopted by the College for written work (« *Normes de présentation matérielle des travaux écrits* »). These can be found in the documentation center on the College web site <http://www.cegepmontpetit.ca/biblio> under the heading « **Aide** ».

## CLASS PARTICIPATION EXPECTATIONS

- Safety rules in the hangar and around aircrafts
- Rules for safe use of equipment and aircrafts

## REQUIRED MATERIAL

- The student notebooks must be downloaded from LEA for each theory classes.
- The student notebooks must be downloaded from LEA for each laboratory classes.
- Safety glasses, safety shoes and appropriate clothing for the laboratory are mandatory

## MEDIAGRAPHY

**Website related to the course:** <http://pmenard.ep.profweb.qc.ca/>

Aircraft Flight control Actuation System Design. E.T. Raymond and C.c. Chenoweth, Society of automotive Engineering Inc. Warrendale, 1993, 270 pages – au complet.

Airplane Aerodynamics. Daniel O'Dommasch. Sydney S.Shelby, Thomas F. Connolly, Pitman Publishing Corporation, 1956, New-York, 621 pages – chapitre 12, pages 388 to 421.

Maintenance des aéronefs, AC4313-1A. F.A.A., Modulo éditeur, Mont-Royal, 1989, 316 pages – chapitre 4, pages 99 to 114.

Cellules et systèmes d'aéronefs. Didier Féminier, Modulo éditeur, Mont-Royal, 1982, 315 pages – chapitres 5 et 6, pages 71 to 99.

Cellule et systèmes. Alain Poujade, Institut aéronautique Jean Mermoz, 1985, Boulogne (France), 376 pages – chapitres 4, 5, 6, pages 71 to 174.

Cellule et circuits. J.C. Ripoli, École nationale de l'aviation civile, Toulouse, 1984, 241 pages – pages 53 to 66.

## *Course Outline 280-5A5-EM: Maintenance of Aircraft Flight Controls and Control Surfaces*

Airframe and Powerplant Mechanics : Airframe Handbook, AC 65-15 ASG. FAA, Basin, Wyo., Aviation Maintenance, 1976, 601 pages.

Aircraft Hydraulic Systems. Crane, Dale, Basin, Wyo., Aviation Maintenance Publishers, C 1975, 91 pages.

Standard Aircraft Handbook. Leavell Stuart et Stanley Bungay, 3e ed., Fallbrook, Californie, Aero, 1980, 155 pages.

A & P Technician Airframe Textbook. Jeppesen, EA-ITP-A2, Englewood, Colorado, 2001, 794 pages

### 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, les conditions particulières concernant le maintien de l'admission d'un étudiant, la Politique de valorisation de la langue française, la Politique pour un milieu d'études et de travail exempt de harcèlement et de violence, les procédures et règles concernant le traitement des plaintes étudiantes.*

The full text of these policies and regulations is accessible on the College web site at the following address: <http://www.cegepmontpetit.ca/campus-de-longueuil/le-college/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.

### OTHER DEPARTMENTAL REGULATIONS

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

<http://ena.cegepmontpetit.ca/>

<http://ena.cegepmontpetit.ca/etudiants-actuels/programmes-d-etudes/departements-d-enseignement#a2>

**NOTE:** This Course Outline is a translation of the *Plan de cours* for 280-543-EM: *Maintenance des commandes et gouvernes d'aéronefs*. If there is a discrepancy, then the original French version will be considered the official version for legal purposes