



Course outline

COURSE: **Hydraulic and pneumatic**

PROGRAM: 280.C0 Aircraft Maintenance



DISCIPLINE: 280-4B5-EM Hydraulic and pneumatic systems (power and control)

WEIGHTING: *Theory:* 2 *Practice:* 3 *Personal Study:* 2

Teacher(s)	Office	 extension	 e-mail
Jacques, Gabriel	C-183	2075	Gabriel.jacques@cegepmontpetit.ca

Office hours

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Morning					
Afternoon		12 :00 to 14 :00			12 :00 to 14 :00
Other					

Coordinator(s)	Office	 extension	 e-mail
Ashby, Paul-Anthony	C- 160	4225	paul-anthony.ashby@cegepmontpetit.ca
Arpin, Stéphanie	C-160	4630	stephanie.arpin@cegepmontpetit.ca

1 CONTEXT OF THIS COURSE WITHIN THE PROGRAM

- This course is intended for 2nd year students enrolled in the Aircraft Maintenance Techniques program and is in the fourth session of this same program.
- The hydraulics and pneumatics course covers the operation, necessary maintenance and troubleshooting of aircraft hydraulic and pneumatic power systems.
- 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) according to Transport Canada requirements. The application of Transport Canada policies regarding absences is available on the [Ma réussite à l'ÉNA](#) website under the heading « Privilèges accordés par Transports Canada ».

2 COMPETENCIES OF THE EXIT PROFILE (STUDENT SKILL PROFILES)

- Carry out maintenance of aircraft systems

3 MINISTERIAL OBJECTIVE(S) AND COMPETENCIES

025U To check the operation (power and control components) of hydraulic and pneumatic systems

4 TERMINAL OBJECTIVE OF THE COURSE (FINAL COURSE OBJECTIVE)

- At the end of the course, the student will be able to diagnose the operation of the power and the control part of hydraulic and pneumatic systems.

5 TEACHING AND LEARNING STRATEGIES

- This course is divided into two distinct parts: a theoretical and practical part.
- The 2-hour theoretical portion of the course will focus on understanding the operation of components, diagrams and the different fluids used in aviation. This will be done through active participation in discussion groups and some masterful presentations. In addition, thanks to troubleshooting tables, the student will be able to isolate the probable causes of a failure or anomaly on different hydraulic and pneumatic systems.
- The practical portion of 3 hours will take place in the laboratory. The student will use, in teams, test benches (rotating every week) to demonstrate the operation of components and put them in the operational context of a system. Using a fault simulator or aircraft hydraulic systems, the student will troubleshoot a set of faults and propose a solution for each of them.

6 COURSE PLAN

LEARNING OBJECTIVES

1. Collect information relating to the operation of the systems.
2. Perform aircraft system start-up.
3. Validate the state of the systems and examine their operation according to the manufacturer's specifications and the pre-established parameters.
4. Diagnose problems.
5. Transmit information.

6.1 THEORETICAL PORTION

SEM	LEARNING OBJECTIVE NUMBER	CONTENTS	OPERATING MODE AND LEARNING ACTIVITIES	RESOURCES, DOCUMENTS, TECHNOLOGY TOOLS AND URL LINKS
1	1 and 5	<ul style="list-style-type: none"> – Presentation of the course outline; – Pascal's law; – Introduction to the symbols of the SAE AS1290 standard; – Single hydraulic circuit manually activated 	<ul style="list-style-type: none"> – Masterful presentation; – Thoughts on how a car jack works. 	<ul style="list-style-type: none"> – Notebooks/course documents; – SAE AS1290 standard.
2	1, 3 and 5	<ul style="list-style-type: none"> – Deepening of the simple hydraulic circuit in aeronautical applications; – Master cylinder and its sub-components; – Application of single-acting cylinders in aviation; 	<ul style="list-style-type: none"> – Introduction of the summary table of components; – Masterful presentation; – Group reflection; – Simple aircraft brake circuit diagram design in hydraulic symbols . 	<ul style="list-style-type: none"> – Notebooks/course documents; – Standard SAE AS1290; – Summary table of components; – Technical documentation.
3	1, 3 and 5	<ul style="list-style-type: none"> – Servo control; – Pressure relief valve; – Fixed flow pump; – Vent tank; – return circuit; – Distributor; – Filtered. 	<ul style="list-style-type: none"> – Masterful presentation; – Group reflection; – Update of the summary table; – Analysis of a hydraulic circuit of a helicopter. 	<ul style="list-style-type: none"> – Notebooks/course documents; – Standard SAE AS1290; – Summary table of components; – Technical documentation.
4	1, 3 and 5	<ul style="list-style-type: none"> – Presentation of the midterm schematic project (Evaluation) – Hydraulic motor – Distributor – Sequential valve – Difference Between Fluids – Redundancy – Accumulator – Transfer cylinder 	<ul style="list-style-type: none"> – Masterful presentation ; – Group reflection; – Update of the summary table ; – Analysis of a hydraulic circuit of a business jet; – Teamwork on the mid-term project 	<ul style="list-style-type: none"> – Notebook / course documents; – Standard SAE AS1290; – Technical documentation ; – Notebooks/course documents; – Summary table of components; – Presentation standards for Cégep written work.

SEM	LEARNING OBJECTIVE NUMBER	CONTENTS	OPERATING MODE AND LEARNING ACTIVITIES	RESOURCES, DOCUMENTS, TECHNOLOGY TOOLS AND URL LINKS
5	1, 3 and 5		<ul style="list-style-type: none"> – Masterful presentation; – Group reflection; – Update of the summary table; – Analysis of a hydraulic circuit of a business jet; – Teamwork on the mid-term project. 	<ul style="list-style-type: none"> – Notebooks/course documents; – Standard SAE AS1290; – Summary table of components; – Technical documentation ; – Presentation standards for Cégep written work.
6	1 and 5		<ul style="list-style-type: none"> – Masterful presentation; – Group reflection; – Update of the summary table; – Analysis of a hydraulic circuit of a business jet; – Teamwork on the mid-term project. 	<ul style="list-style-type: none"> – Notebooks/course documents; – Standard SAE AS1290; – Technical documentation ; – Summary table of components; – Presentation standards for Cégep written work.
7	1, 3 and 5		<ul style="list-style-type: none"> – Teamwork to be handed over; – Masterful presentation; – Group reflection; – Analysis of a hydraulic circuit of a business jet; – Update the summary table. 	<ul style="list-style-type: none"> – Notebooks/course documents; – Standard SAE AS1290; – Technical documentation ; – Summary table of components; – Presentation standards for Cégep written work.
			<ul style="list-style-type: none"> – Submission of the midterm schematic project (evaluation) 	
8	1 and 5	<ul style="list-style-type: none"> – Emergency system 	<ul style="list-style-type: none"> – Masterful presentation; – Group reflection; – Analysis of aircraft emergency circuits; – Update the summary table. 	<ul style="list-style-type: none"> – Notebook / course documents; – Standard SAE AS1290; – Summary table of components; – Technical documentation.
9	1 and 5	<ul style="list-style-type: none"> – Emergency system 	<ul style="list-style-type: none"> – Masterful presentation; – Group reflection; – Analysis of aircraft emergency circuits; – Update the summary table. 	<ul style="list-style-type: none"> – Notebooks/course documents; – Standard SAE AS1290; – Summary table of components; – Technical documentation.

SEM	LEARNING OBJECTIVE NUMBER	CONTENTS	OPERATING MODE AND LEARNING ACTIVITIES	RESOURCES, DOCUMENTS, TECHNOLOGY TOOLS AND URL LINKS
10	1, 4 and 5	<ul style="list-style-type: none"> - Introduction to troubleshooting: - Why : - Operation vs. inspection - How : - Hydraulic fundamentals - Methodology 	<ul style="list-style-type: none"> - Masterful presentation; - Group reflection; - Update of the summary table; - Research into possible system/component failures. - Organization of the process - 	<ul style="list-style-type: none"> - Notebooks/course documents; - Standard SAE AS1290; - Summary table of components; - Technical documentation.
11	1, 4 and 5	<ul style="list-style-type: none"> - Data acquisition - Technical documentation - Hypothesis testing 	<ul style="list-style-type: none"> - Masterful presentation; - Group reflection; - Update of the summary table; - Research into possible system/component failures. - Organization of the process - 	<ul style="list-style-type: none"> - Notebooks/course documents; - Standard SAE AS1290; - Summary table of components; - Technical documentation.
12	1, 4 and 5	<ul style="list-style-type: none"> - Overview of troubleshooting flowchart project - Troubleshooting: - How : - Hydraulic fundamentals - Methodology - Data acquisition - Technical documentation - Hypothesis testing 	<ul style="list-style-type: none"> - Masterful presentation; - Group reflection; - Update of the summary table; - Research into possible system/component failures. - Organization of the process - Work on the end of the semester project. 	<ul style="list-style-type: none"> - Notebooks/course documents; - Standard SAE AS1290; - Summary table of components; - Technical documentation. - Hydraulic diagram and description of the hydraulic circuit developed in the teamwork submitted to week 7
13	1, 4 and 5	<ul style="list-style-type: none"> - Troubleshooting: - How : - Hydraulic fundamentals - Methodology - Data acquisition - Technical documentation - Hypothesis testing 	<ul style="list-style-type: none"> - Masterful presentation; - Group reflection; - Update of the summary table; - Research into possible system/component failures. - Organization of the process - Work on the end of the semester project. 	<ul style="list-style-type: none"> - Notebook / course documents; - Standard SAE AS1290; - Technical documents . - Hydraulic diagram and description of the hydraulic circuit developed in the teamwork submitted to week 7
14	1, 4 and 5	<ul style="list-style-type: none"> - Troubleshooting: - How : - Hydraulic fundamentals - Methodology - Data acquisition - Technical documentation - Hypothesis testing 	<ul style="list-style-type: none"> - Masterful presentation; - Group reflection; - Update of the summary table; - Research into possible system/component failures. - Organization of the process - Work on the end of the semester project. 	<ul style="list-style-type: none"> - Notebooks/course documents; - Standard SAE AS1290; - Technical documentation ; - Hydraulic diagram and description of the hydraulic circuit developed in the teamwork submitted to week 7

SEM	LEARNING OBJECTIVE NUMBER	CONTENTS	OPERATING MODE AND LEARNING ACTIVITIES	RESOURCES, DOCUMENTS, TECHNOLOGY TOOLS AND URL LINKS
15	1, 4 and 5	– Delivery of the troubleshooting flowchart project (evaluation)	– Complete the creation of a troubleshooting flowchart and submit it	– Hydraulic diagram and description of the hydraulic circuit developed in the team work submitted to week 7; – Technical documentation ; – Summary table of components; – Presentation standards for Cégep written work.

6.2 LABORATORY PART

SEM	LEARNING OBJECTIVE NUMBER	CONTENTS	OPERATING MODE AND LEARNING ACTIVITIES	RESOURCES, DOCUMENTS, TECHNOLOGY TOOLS AND URL LINKS
1	1, 2, 3 and 5	– Course outline – Health and security – Technical writing/initiation to test benches.	– Masterful presentation; – Health and safety activity; – Amatrol test benches. –	– Amatrol test benches; – New employee document; – Technical documentation ; – Dynamic questionnaire; – Course books. –
2	1, 2, 3 and 5	– Distinction between flow and pressure	– Masterful presentation; – Realization of assemblies on Amatrol test benches; – Group reflection.	– Note book ; – Amatrol test benches; – Technical documentation ; – Dynamic questionnaire; – New employee document.
3	1, 2, 3 and 5	– Incoming and outgoing flow	– Masterful presentation; – Realization of an assembly on the Amatrol test benches; – Group reflection.	– Amatrol test bench; – New employee document; – Technical documentation ; – Dynamic questionnaire; – Course books.

SEM	LEARNING OBJECTIVE NUMBER	CONTENTS	OPERATING MODE AND LEARNING ACTIVITIES	RESOURCES, DOCUMENTS, TECHNOLOGY TOOLS AND URL LINKS
4	1, 2, 3 and 5	– Hydraulic motors	– Realization of assemblies on Amatrol test benches; – Masterful presentation; – Group reflection.	– Amatrol test bench; – New employee document; – Technical documentation ; – Dynamic questionnaire; – Course books.
5	1, 2, 3 and 5	– Accumulators	– Realization of assemblies on Amatrol test benches; – Masterful presentation; – Group reflection .	– Amatrol test bench ; – New employee document; – Technical documentation ; – Dynamic questionnaire; – Course books.
6	1, 2, 3 and 5	– Mechanical controls and electro-hydraulic valves	– Realization of assembly on Amatrol test benches; – Masterful presentation; – Group reflection.	– Amatrol test bench; – New employee document; – Technical documentation ; – Dynamic questionnaire; – Course books.
7	1, 2, 3 and 5	– Evaluation: Realization of a hydraulic assembly and validation of functionality (Evaluation)	– Carry out an assembly on the Amatrol test benches from a diagram and check its operation.	– Amatrol test bench; – New employee document; – Technical documentation ; – Course books.
8	1, 2, 3 and 5	– Review on the exam – Mechanical controls and electro-hydraulic valves	– Realization of assembly on Amatrol test benches; – Masterful presentation; – Group reflection	– Amatrol test bench; – New employee document; – Technical documentation ; – Dynamic questionnaire; – Course books.
9	1, 2, 3 and 5	– Start up and adjustment of the fault simulator	– Realization and adjustment of an assembly on the fault simulators; – Masterful presentation; – Group reflection.	– Fault simulator; – course books; – Technical documentation; – New employee document.
10	1, 2, 3 and 5	– Troubleshooting on fault simulators ○ Overload load	– Realization and adjustment of an assembly on the fault simulators; – Masterful presentation; – Group reflection.	– Fault simulator; – course books; – Technical documentation ; – New employee document.

SEM	LEARNING OBJECTIVE NUMBER	CONTENTS	OPERATING MODE AND LEARNING ACTIVITIES	RESOURCES, DOCUMENTS, TECHNOLOGY TOOLS AND URL LINKS
11	1, 2, 3 and 5	<ul style="list-style-type: none"> - Troubleshooting on fault simulators <ul style="list-style-type: none"> o Compressive load 	<ul style="list-style-type: none"> - Realization and adjustment of an assembly on the fault simulators; - Masterful presentation; - Group reflection. 	<ul style="list-style-type: none"> - Fault simulator; - course books; - Technical documentation ; - New employee document.
12	1, 2, 3 and 5	<ul style="list-style-type: none"> - Troubleshooting on fault simulators <ul style="list-style-type: none"> o Hydraulic motor 	<ul style="list-style-type: none"> - Realization and adjustment of an assembly on the fault simulators; - Masterful presentation; - Group reflection. 	<ul style="list-style-type: none"> - Fault simulator; - course books; - Technical documentation ; - New employee document.
13	1, 2, 3, 4 and 5	<ul style="list-style-type: none"> - Troubleshooting on fault simulators <ul style="list-style-type: none"> o random system 	<ul style="list-style-type: none"> - Realization and adjustment of an assembly on the fault simulators; - Masterful presentation; - Group reflection. 	<ul style="list-style-type: none"> - Fault simulator; - course books; - Technical documentation ; - New employee document.
14	1, 2, 3, 4 and 5	<ul style="list-style-type: none"> - Troubleshooting on fault simulators <ul style="list-style-type: none"> o random system 	<ul style="list-style-type: none"> - Realization and adjustment of an assembly on the fault simulators; - Masterful presentation; - Group reflection. 	<ul style="list-style-type: none"> - Fault simulator; - course books; - Technical documentation ; - New employee document.
15	1, 2, 3, 4 and 5	<ul style="list-style-type: none"> - Terminal evaluation 	<ul style="list-style-type: none"> - Diagnosis of the hydraulic system of the fault simulator from a work order. 	<ul style="list-style-type: none"> - Fault simulator; - course books; - Technical documentation ; - New employee document.

7 SYNTHESIS OF SUMMATIVE EVALUATION METHODS

Method of evaluation and description of the activity	Realization context	Learning objective(s)	Evaluation criteria	Deadline (date)	Weighting (%)
Realization of an assembly using a hydraulic diagram and functional validation on test bench simulators	In the laboratory, individual	1, 2, 3 and 5	<ul style="list-style-type: none"> – Accurate identification of information; – Ability to achieve expected results; – Understanding of a hydraulic diagram in symbols; – Safe use of test benches. 	Week 7	10%
Schematization of an aircraft hydraulic system and description of each component that forms it with the definition of its utility on the circuit	In theory, as a team	1, 3 and 5	<ul style="list-style-type: none"> – Correct description of the components; – Utility of components well defined; – Schematization of the system respecting the AS1290 graphic standard; – Compliance with Cégep presentation standards. 	Week 7	15%
Creation of a troubleshooting table	In theory, individual	1, 3, 4 and 5	<ul style="list-style-type: none"> – Clear organization of the troubleshooting process in the flowchart; – Precise definition of the probable causes; – Accurate description of problems and solutions; – Compliance with Cégep presentation standards. 	Week 15	25%
Terminal Evaluation Troubleshooting on a fault simulator	In the laboratory, individual	1, 2, 3, 4 and 5	<ul style="list-style-type: none"> – Accurate identification of information; – Safe use of the troubleshooting simulator; – Ability to identify the problem and propose a solution in a given time; – Technical writing done according to the new employee document; – Compliance with Cégep presentation standards. 	Week 15	50%
				TOTAL	100%

8 REQUIRED MATERIAL

The necessary documents will be provided on the Teams group of the course

9 BIBLIOGRAPHIE

- Amatrol, Inc. (2014). *Advanced Hydraulics Student Reference* (éd. 1e, v5.02). Jeffersonville, Indiana, États-Unis d'Amérique: Amatrol, Inc.
- Amatrol, Inc. (2021). *Basic Hydraulics (Virtual Trainer Enabled) Student Reference* (éd. 1e, v5.08000). Jeffersonville, Indiana, États-Unis d'Amérique: Amatrol, Inc.
- Amatrol, Inc. (2021). *Electro-Fluid Power Systems Student Reference* (éd. 1e, v6.00000). Jeffersonville, Indiana, États-Unis d'Amérique: Amatrol, Inc.
- Amatrol, Inc. (2021). *Instructor's Guide 85-AH Advanced Hydraulics Learning System* (éd. 1e, Rev. J). Jeffersonville, Indiana, États-Unis d'Amérique: Amatrol, Inc.
- Amatrol, Inc. (2021). *Instructor's Guide 85-BH Basic Hydraulics Learning System* (éd. 1e, Rev. E). Jeffersonville, Indiana, États-Unis d'Amérique: Amatrol, Inc.
- Amatrol, Inc. (2021). *Instructor's Guide 85-IH Intermediate Hydraulics Learning System* (éd. 1e, Rev. J). Jeffersonville, Indiana, États-Unis d'Amérique: Amatrol, Inc.
- Amatrol, Inc. (2021). *Intermediate Hydraulics Student Reference* (éd. 1e, v5.10000). Jeffersonville, Indiana, États-Unis d'Amérique: Amatrol, Inc.
- Instructor's Guide 85-EF Electro-Fluid Power Learning System* (éd. 1e, Rev. B). (2021). Jeffersonville, Indiana, États-Unis d'Amérique: Amatrol, Inc.
- Ministère de la Justice Canada. (2022, Décembre 21). *Ministère de la Justice Canada*. Consulté le Janvier 18, 2023, sur Site Web de la législation (Justice): <https://lois-laws.justice.gc.ca/PDF/SOR-96-433.pdf>
- Society of Automotive Engineering International. (2021). *AS1290C: (R) Graphic Symbols for Aircraft Hydraulic and Pneumatic Systems*. SAE International, SAE Aerospace Standard. Warrendale: SAE International.

10 REQUIREMENTS TO PASS THE COURSE

1. Passing Mark

The passing mark for this course is 60% by adding the marks for the theory and practical work for the course.

2. Attendance for Summative Evaluations

Students must be present for summative evaluations and must comply with the instructions given by the instructor to carry out the evaluation activity and written in the course outline. Unexcused tardiness for a summative evaluation could result in being excluded from the activity. Any absence from a summative evaluation that is not due to serious reasons (illness, death in the family, etc.) could result in a mark of zero (0) for the activity.

Students are responsible for meeting with the instructor before an evaluation activity is held or immediately upon returning to ENA to explain the reason for an absence. Proper documentation, such as a medical certificate, a death certificate, legal papers, etc., must be shown if the reason for absence is serious and recognized as such by the instructor(s), arrangements will be made between the instructor(s) and the student to make up the activity.

3. Submitting Assignments

All assignments must be submitted by the date, hour and location designated by the instructor(s). Late assignments will be penalized 10% per day that they are late and will receive a mark of zero (0) after 6 days.

4. Presentation of Written Work

The instructor(s) will provide students with information and guidelines regarding the presentation of written work. When the presentation of an assignment is unacceptable, the work will be penalized as a late assignment until an acceptable

version is submitted. In this case, the penalties for late work will be applied (Late assignments will be penalized 10% per day that they are late and will receive a mark of zero (0) after 6 days).

Students must follow the standards adopted by the Cégep for written work (« *Normes de présentation matérielle des travaux écrits* »). These can be found at : <http://rmsh.cegepmontpetit.ca/normes-de-presentacion-materielle-des-travaux-ecrits-du-cegep/>.

11 METHODS OF COURSE PARTICIPATION

Appropriate clothing for laboratories is:

- Safety shoes.
- Work clothes.
- Safety glasses.

Students who do not respect the dress/safety code will not be admitted to the laboratory.

Refer to the New Employee Handbook for full details regarding expected values and behaviours.

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.