

# 280-3D4-EM FALL 2020 Avionics Department

# **COURSE OUTLINE**

COURSE: Direct-Current Avionics Systems

**PROGRAM:** 280.C0 Aircraft Maintenance

**DISCIPLINE**: 280 Aeronautics

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

Your Teacher	Office		
Chevalier, Mathieu	A-192	4681	mathieu.chevalier@cegepmontpetit.ca
Daigle, Jean-François	A-192	4638	jean-francois.daigle@cegepmontpetit.ca
Desruisseaux, Benoit	A-187	4486	benoit.desruisseaux@cegepmontpetit.ca
Gagnon, Marie-Hélène	A-192	4131	marie-helene.gagnon@cegepmontpetit.ca
Gillard, Pierre	A-187	4552	pierre.gillard@cegepmontpetit.ca
Laurin, Nicholas	A-192	4665	nicholas.laurin@cegepmontpetit.ca
Lavallée, Éric	A-187	4132	eric.lavallee@cegepmontpetit.ca
Levasseur, Jacques	A-187	4399	jacques.levasseur@cegepmontpetit.ca
Morin, Frédéric	A-187	4397	fa.morin@cegepmontpetit.ca
Parenteau, Martin	A-192	4675	martin.parenteau@cegepmontpetit.ca
Richer, Jean-François	A-192	4130	jean-francois.richer@cegepmontpetit.ca
Séguin-Brodeur, Judith	A-192	4103	j.seguin-brodeur@cegepmontpetit.ca

## **OFFICE HOURS FOR STUDENTS**

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Morning					
Afternoon					
Other					

Coordinator(s)	Office	🕿 extension	
Laurin, Nicholas	A-192	4665	nicholas.laurin@cegepmontpetit.ca
Parenteau, Martin	A-192	4675	martin.parenteau@cegepmontpetit.ca

This course outline is the translation of "Plan de cours – 280-354-EM – Avionique des systèmes de courant continu". In case of any contradictions, the French version, which is the original, prevails.

#### **CONTEXT OF THIS COURSE IN THE PROGRAM**

This course is offered during the third session of the program.

By the end of the course, students will be able to use their understanding of electrical systems to acquire other skills in electricity and aircraft electronics.

This course is an absolute prerequisite for 280-533-EM.

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 ENA website and in the student agenda under the heading « Privilèges accordés par Transports Canada ».

### **COMPETENCIES OF THE EXIT PROFILE (STUDENT SKILL PROFILES)**

Master the aeronautical maintenance techniques.

#### MINISTERIAL OBJECTIVE(S) AND COMPETENCIES

# 025T To maintain direct-current circuits on an aircraft. (Training time: 100 class periods)

➤ 3 <sup>rd</sup> session	280-3D4-EM: Direct-Current Avionics Systems	55 periods of 100
4 <sup>th</sup> session	280-4A4-EM: Direct-Current Avionics Systems	30 periods of 100
6 <sup>th</sup> session	280-6A3-EM: Avionics Maintenance	15 periods of 100
Total:		100 periods

# 0263 To verify simple alternating-current circuits on an aircraft. (Training time: 70 class periods)

Distribution of Compotones 0262 in the program

<u>Distribution of </u>	of Competence (	<u>0263 in the program :</u>	
→ 3 <sup>rd</sup> session	280-3D4-EM:	Direct-Current Avionics Systems	5 periods of 70
4 <sup>th</sup> session	280-4A4-EM:	Direct-Current Avionics Systems	30 periods of 70
4 <sup>th</sup> session	280-605-EM:	Aircraft Instrumentation	5 periods of 70
6 <sup>th</sup> session	280-6A3-EM:	Avionics Maintenance	30 periods of 70
Total:			70 periods

# TERMINAL OBJECTIVE OF THE COURSE (FINAL COURSE OBJECTIVE)

At the end of the course, the student will be able to troubleshoot electrical generation and distribution systems on single piston aircraft.

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#### **TEACHING AND LEARNING STRATEGIES**

### Theory:

The theoretical course will be delivered asynchronously remotely with multimedia support when possible and appropriate. Among others, simulation software such as *Multisim* will be used to quickly simulate circuit operation.

#### **Practical Work:**

Acquisition of the theoretical knowledge will be facilitated by a series of experiments divided into 14 laboratory sessions.

# **COURSE PLAN**

#### 025T To maintain direct-current circuits on an aircraft.

Element of the Ministerial Objective	Learning Objective	Transport Canada Reference
#1. Take measurements on : - series circuits - parallel circuits - series-parallel circuits	THE STRUCTURE OF MATTER  1. Define the basic elements of the structure of matter - identify the internal organization of the atom; atomic forces - distinguish atoms and ions	
	STATIC LOADS  2. Plot the forces exerted on electrical charges on a Cartesian plane.	
	Explain the effect of electrical field on a charge in space.     Explain the relationship between electrical field and potential energy of an electric charge.	
	Define the concept of electric potential.     Explain the means of protection against static electricity used in an aircraft.	
	7 Check the installation of static dischargers and the presence and condition of protection braids on moving surfaces.	
	MOVING CHARGES  8. Find relationships and differences between the concepts of power and energy.	
	<ul><li>9. Define the concept of electric current.</li><li>10. Define the quantities used in electricity and identify their units of measure.</li></ul>	
	<ul><li>11. Define the relationship between the electric potential difference, current and electric resistance.</li><li>12. Identify methods used to produce electrical energy</li></ul>	
	onboard aircraft.  13. Describe the characteristics of resistance.  14. Identify types of electrical circuits on aircraft.	
	<ul><li>15. Solve a simple circuit made up of two or more resistors, in series and in parallel.</li><li>16. Solve a mixed circuit (series-parallel)</li></ul>	
	<ul><li>17. Use a multimeter as: voltmeter, ammeter and ohmmeter.</li><li>18. Check a faulty circuit with a multimeter.</li></ul>	
	Explain the factors that affect the resistance of a circular lead wire.	

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Element of the Ministerial Objective	Learning Objective	Transport Canada Reference
#2. Verify the direct current of passive components.	Check the operation of various control devices used in circuits:         - All types of switches         - Various types of relays     Check the operation of various protective devices: temperature, pressure, light and position transducers     Check the operation of various protective devices.     Interpret plans and diagrams involving semi-conductor components.	
#3. Verify the direct-current	Check the operation of a DC generator	
electrical power supply and distribution system	2. Check the operation of a D.C. electric motor.	
of an aircraft.	Check a DC generation system of a single engine piston aircraft	
	<ol> <li>Check a DC generation system on a single engine turbine aircraft.</li> </ol>	
	<ol> <li>Check a DC distribution system of a single engine piston and a single engine turbine aircraft while respecting safety procedures.</li> </ol>	
	<ol> <li>Diagnose malfunctions in the DC generation and distribution systems of a single engine piston and a single engine turbine aircraft.</li> </ol>	
#5. Test the operation of lead-acid batteries.	Describe in general the principle of chemical reactions that occur in the lead-acid batteries while charging and discharging.	
	Explain the procedure for handling lead-acid batteries.	
	3. Explain the steps in the initial operation of a lead-acid battery.	
	Explain the procedure for complete maintenance of a lead- acid battery.	
#7. Determine the charge balance of a direct-current circuit in an aircraft.	Identify information relevant to the electrical load analysis for a single engine aircraft:     AC 43 13     FAR 23     JAR 23     Manufacturer's manuals  Identify regulations concerning the need to mandatorily	
	perform a new electric load analysis .	

# 0263 To inspect the operation of simple alternating-current circuits on an aircraft

I	Element of the Ministerial Objective		Learning Objective	Transport Canada Reference
#1	Describe in general the principle of chemical reactions that occur in nickel cadmium batteries while charging and discharging.	2.	Make conclusions from chemical reactions regarding inspection methods that cannot be used with nickel cadmium batteries.  Explain the procedure for handling nickel cadmium batteries.	
	onarging and discharging.	3.	Explain the maintenance procedure for a nickel cadmium battery.	

# **Session Calendar:**

# Theory:

Peri	ods	Content		Personal Study	
	1 per	Introduction to the course	Course Outline		
Week 1	1 per	Structure of Matter Static Charges	<ul> <li>Structure of atoms</li> <li>Conductors, insulators and semi- conductors</li> <li>Definition of Coulomb unit</li> <li>Explanation of the use of static dischargers and bonding braids on an aircraft.</li> </ul>	Study: PowerPoint of the week Reference manual:Aircraft Electricity & Electronics 7th edition. Weekly exercises to do at home in the reference manual.	#1.1 to #1.7 (025T)
Weeks 2 to 4	6 per	Concepts of voltage, current and resistance  Ohm's Law  Concepts of power and energy  Series circuits Parallel circuits  Explanation of an equivalent circuit  Mixed circuits	<ul> <li>Definition of voltage</li> <li>Sources of voltage</li> <li>Definition of current</li> <li>Definition of resistance</li> <li>Types of resistors used in aircraft circuitry</li> <li>Common components of an electrical circuit (relay, switch, fuse, lamp)</li> <li>Identification of a series circuit. Circuits of anti-collision lights, gas levels and others will be explained.</li> <li>Voltage in a series circuit</li> <li>Current in a series circuit</li> <li>Equivalent resistance –series</li> <li>Power in a series circuit</li> <li>Laws applied to series circuits</li> <li>Identification of a parallel circuit. The circuits of navigation lights, landing lights and others will be explained.</li> <li>Voltage in a parallel circuit</li> <li>Current in a parallel circuit</li> <li>Equivalent resistanceparallel</li> <li>Power in a parallel circuit</li> <li>Laws applied to parallel circuits</li> <li>Identification in a mixed circuit of the relationships in series and in parallel</li> <li>Total current of a mixed circuit; current in the branches.</li> <li>Equivalent resistance in a mixed circuit</li> <li>Examples of simple malfunctions in parallel series circuits</li> </ul>	Study: PowerPoint of the week Reference manual:Aircraft Electricity & Electronics 7 <sup>th</sup> edition. Weekly exercises to do at home in the reference manual.	#1.6 to #1.16 (025T)
Week 5	2 per.	Resistance of a circular lead wire	<ul> <li>Resistance of conductors</li> <li>Types and characteristics of conductors used in aeronautics: AC 43.13-1B and AC 43.13-2A</li> <li>Definition of a circular mil</li> <li>Selecting a gage of wire according to the criteria of voltage, current and distance from the source.</li> <li>Protection devices</li> </ul>	Study:  PowerPoint of the week  Reference manual:Aircraft Electricity & Electronics 7th edition.  Weekly exercises to do at home in the reference manual.	#2.1 (025T)

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Peri	ods	Content Personal Study		Personal Study	Objectives
Week 6	2 per.	Semi-conductors	<ul> <li>N, P-type materials, PN junctions and polarization of PN junctions</li> <li>Recognizing the symbol for diodes (rectifiers)</li> <li>Functions of diodes         <ul> <li>Switching circuits</li> <li>Free-wheel circuits</li> <li>LED</li> <li>photodiodes</li> </ul> </li> <li>Other functions of the diode (Rectifier circuits will be studied in the course 280-404)</li> </ul>	Study:  PowerPoint of the week  Reference manual:Aircraft Electricity & Electronics 7 <sup>th</sup> edition.  Weekly exercises to do at home in the reference manual.	
Week 7	2 per.	Batteries	Lead-acid batteries     Nickel-Cadmium Batteries     Principle of chemical reactions	Study: PowerPoint of the week Reference manual:Aircraft Electricity & Electronics 7 <sup>th</sup> edition. Weekly exercises to do at home in the reference manual.	#2.2 (025T) #2.3 (025T) #2.5 (025T)
Week EC	2 per	Exam 1 (20 points); Week of October 19, 2020			
Weeks 8 to 10	6 per.	DC electrical machines	Qualitative study of  Concepts of electromagnetism DC output alternator DC generator Voltage regulator DC motor Starter Generator	Étude:     PowerPoint of the week     Reference manual:Aircraft     Electricity & Electronics 7 <sup>th</sup> edition.     Weekly exercises to do at home in the reference manual.	#2.5 (025T)
Weeks 11 to 13	6 per.	Power generation, distribution and starting systems for piston and turbine single engines.	<ul> <li>Using diagrams of a single-engine piston aircraft (Cessna 172 and other examples) make an analysis:         <ul> <li>of the power generation and distribution system of electrical energy</li> <li>of the starter system</li> </ul> </li> <li>Using diagrams of a single-engine turbine aircraft (Bell 206 and other examples) make an analysis of:         <ul> <li>the power generation and distribution system of electrical energy</li> <li>starting system</li> </ul> </li> <li>Explain the electrical load analysis on an aircraft.</li> </ul>	Study:  PowerPoint of the week  Reference manual:Aircraft Electricity & Electronics 7 <sup>th</sup> edition.  Weekly exercises to do at home in the reference manual.	#5.1 (025T) #1.1 (0263)
Week 14	2 per	Exam 2 (Final) (3	0 points); EC Weeks from December 18 to 2	24, 2020	ALL

# **Practical Work:**

Peri	ods	Content		Personal Study	Objectives
Weeks 1, 2, 3 and 4	6 per	Introduction to the course  Inspecting switches and relays	- Safety concepts in the avionics laboratory - Digital Multimeter: Explanation of the voltmeter. Measuring DC voltage on a power supply and batteries.  Static tests with the Ohm meter: a) Explanation of the Ohm meter b) Measuring resistance c) SPST, DPDT, SPDT, DPDT switches d) Circuit-breakers and fuses e) SPST, SPDT relays f) Circuit testing The inspection will determine whether the component is functioning	Laboratory Preparation: Read the corresponding laboratory activity text Laboratory Reports: Record the measurements taken and compare them with the theoretical values. Comment on the results = 50% of the report's mark. Professor will ask individual questions to verify the student's comprehension = 50% of the report's mark.	#1.17 (025T) #2.2 (025T) #2.4 (025T)
Week 5-6	2 per	Presentation and use of the DC simulator (Familiarization with) Using the wiring diagram in order to use the Voltmeter	In rotation: A practical presentation of how to use the DC simulator (FR601-M) by the teacher Explanation and demonstration on the operation of a ground power unit used with simulator (30 min.). Students will use the simulator as operators to start various systems.  - Identifying elements on the diagram - Identifying elements on the simulator - Measuring voltage and resistance on the different elements of the DC simulator (FR601-M). (90 min)	Laboratory Preparation: Read the corresponding laboratory activity text Laboratory Reports: Complete the procedures taken. Comment on the results.	#1.12 (025T) #1.14 (025T)
Week 5-6	2 per	Research done in class	In rotation: Classroom research on the function of different components of the electrical generation system.	Laboratory Preparation: Read the corresponding laboratory activity text Laboratory Reports: Research report to be submitted at the beginning of the next class.	#1.17 (025T) #1.18 (025T)
Week 7 et 8	4 per	Troubleshooting systems Finding defects	Troubleshooting FR601-M DC single engine simulator using the voltmeter or the Ohm meter in compliance with the 14 V piston single engine Procedures Manual (executing a test procedure). Failures will be of the opencircuit type.  Systems studied: - Anti-collision - Navigation lights - Landing lights - Fuel level	Laboratory Preparation: Read the corresponding laboratory activity text Laboratory Reports: Record the measurements taken and compare them with the theoretical values. Comment on the results.	#1.18 (025T) #2.5 (025T) #3.3 (025T) #3.4 (025T) #3.5 (025T)

Periods		Content		Personal Study	Objectives
Week 9	2 per	Troubleshooting Exam	Individually, using 14V piston single engine Procedures Manual students will find on the DC datasheet (FR601-M) the system defect chosen by the teacher. Open-circuit type failure Systems on the exam: - Anti-collision - Navigation lights - Landing lights - Fuel level		#1.18 (025T) #2.5 (025T) #3.3 (025T) #3.4 (025T) #3.5 (025T)
Week 10-11	2 per	Research done at home	In rotation: Research on the elements of an aircraft generation and start system.	Laboratory Preparation: Study class notes on that subject. Laboratory Reports: Research report to be submitted at the beginning of the next class.	#1.18 (025T) #2.5 (025T) #3.3 (025T) #3.4 (025T) #3.5 (025T)
Week 10-11	2 per	Inspecting the DC power generation system on an aircraft  Static dischargers and bonding braids.	In the hangar: Check the operation of the power generation system on a running single engine piston aircraft (run-up)  In the hangar: Students will locate bonding braids and dischargers on the following aircraft: Cessna, Piper, Aerocommander, Beechcraft 90, Bell 206 and Astar 350	Laboratory Preparation: Study the systems diagrams discussed in class which are in the indicated aircraft manuals. Laboratory Reports: Record the condition of the inspected systems. Laboratory Preparation: Read text corresponding to CAR 551.200 and Standards AC43-13 Prepare the load balance. Laboratory Reports: Record the activities and measurements taken and compare them with the theoretical values. Comment on the results.	#3.3 (025T) #1.6 (025T) #1.7 (025T)
Week 12-13	2 per	Research done at home	In rotation: Research on the elements of an aircraft generation and start system.	Laboratory Preparation: Study class notes on that subject. Laboratory Reports: Research report to be submitted at the beginning of the next class.	#5.1 (025T) #5.2 (025T) #5.3 (025T) #5.4 (025T)
Week 12-13	2 per	Troubleshooting exercises	In rotation: Troubleshooting exercise using the DC simulator (FR601-M) (starting and generation).	Laboratory Preparation: Read the corresponding texts in the Course Notes and the Reference Manual Laboratory Reports: Record activities and measurements taken and compare them with the theoretical values. Comment on the results.	#5.1 (025T) #5.2 (025T) #5.3 (025T) #5.4 (025T)
Week 14	2 per	Exam on power generation or starter circuit troubleshooting	Individually, students will use the <u>14V piston</u> <u>single engine Procedures Manual</u> , to find system defects selected by the instructor (starting or power generation) on the DC simulator (FR601-M)		

### **SYNTHESIS OF SUMMATIVE EVALUATION METHODS**

# Theory

Description of Evaluation Activity	Context and evaluation manner	Learning Objective(s)	Evaluation Criteria	Due Date (date assignment is due or exam given)	Weighting (%)
Quiz#1	Online via Moodle; 30 min	1.1 to 1.7, 2.1 (025T)	According to MCF and PIEA	Week 5	5%
Quiz#2	Online via Moodle; 30 min	1.1 to 1.16, 2.1(025T) 5.1(025T) 1.1(025T)	According to MCF and PIEA	Week 11	5%
Exam 1 Commun examination in person	Time: 2 periods	1.1 to 1.16 (025T)	According to MCF and PIEA	Week of October 19; EC	20%
EXAM 2 course's TERMINAL ÉVALUATION Commun examination in person	Time: 2 periods	All	According to MCF and PIEA	Week 14; EC	30%

Sub-total: 60%

# **Practical Work**

Description of Evaluation Activity	Context	Learning Objective(s)	Evaluation Criteria	Due Date (date assignment is due or exam given)	Weighting (%)
1,2,3. Inspection of switches and relays	Laboratory work (50%) Comprehension question with professor 4 <sup>th</sup> (50%)	#1.17(025T) #2.2 (025T) #2.4 (025T)	According to MCF and PIEA	Week 4	4%
5-6. In rotation. Research done in class.			According to MCF and PIEA	Week 5 or 6 according to the rotation	2%
9. Troubleshooting Exam	ÉVALUATION 1 (Individual)	#1.18 (025T) #2.5 (025T) #3.3 (025T) #3.4 (025T) #3.5 (025T)	According to MCF and PIEA	Week 9	8%
10-11. In rotation: Research on the elements of an aircraft generation and start system.		1.18 (025T) #2.5 (025T) #3.3 (025T) #3.4 (025T) #3.5 (025T)	According to MCF and PIEA	Week 11 or 12 according to the rotation	3%
12-13. In rotation. Demonstrate maintenance of lead-acid and Nickel-Cadmium batteries		#5.1 (025T) #5.2 (025T) #5.3 (025T) #5.4 (025T) #1.1 (0263) #1.2 (0263) #1.3 (0263)	According to MCF and PIEA	Week 13 or 14 according to the rotation	3%
14. Troubleshooting Exam on power generation circuit or starting circuit	EVALUATION 2 (Individual)	#1.1 (0263) #1.2 (0263) #1.3 (0263) #1.1 (0263)	According to MCF and PIEA	Week14; EC	20%

Sub-total: 40%

TOTAL: **100%** 

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#### **MEDIAGRAPHY**

#### Mandatory manual

EISMIN, THOMAS K. – Aircraft Electricity & Electronics, \*<u>7th Edition</u>, McGraw-Hill, 2019. ISBN 978-1-260-10821-7

\*NO OTHER VERSION WILL BE ACCEPTED

# **REQUIREMENTS TO PASS THE COURSE**

### (1) Passing Mark

The passing mark for this course is 60% (PIEA, article 5.1m).

#### (2) Tardiness

Students who arrive late after the beginning of the first period of a course are considered absent for this period.

# (3) Attendance for Summative Evaluations

Attendance at summative assessment activities is mandatory (PIEA article 5.2.5.1)

#### (4) Submitting Assignments

Homeworks required by a teacher must be submitted to the date, the place and time set. The penalties associated with delays are established according to departmental rules (PIEA, section 5.2.5.2).

In case of delay penalties are:

 See section «Règles des départements» at the following link: http://guideena.cegepmontpetit.ca/regles-des-departements/

### (5) Presentation of Written Work

The student must meet the "Written Work Standard Presentation" adopted by the CEGEP. Non-compliance of these standards may delay the acceptance of the work or affect the rating granted. These standards are available in **Flash Links**, **Bibliothèques** under "**Méthodologie**" of the CEGEP Documentation Centers at: <a href="www.cegepmontpetit.ca/normes">www.cegepmontpetit.ca/normes</a>.

The **departmental penalties** for non-compliance with Written Work Standard Presentation (PIEA, article 5.3.2) are:

 See section « Règles des départements » at the following link: <a href="http://guideena.cegepmontpetit.ca/regles-des-departements/">http://guideena.cegepmontpetit.ca/regles-des-departements/</a>

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#### **CLASS PARTICIPATION EXPECTATIONS**

Laboratory safety and use of the premises:

Students must be under the supervision of a teacher or a technician whenever they are in the laboratory or using the equipment, unless otherwise indicated.

Any student whose conduct in the laboratory poses a risk to others will receive a warning from the teacher and then be excluded from the laboratory until the case can be reviewed by the teacher and the coordinator of the Avionics Department.

#### **OTHER DEPARTMENTAL REGULATIONS**

Students are encouraged to consult the website for the specific regulations for this course: <a href="http://guideena-en.cegepmontpetit.ca/department-rules/">http://guideena-en.cegepmontpetit.ca/department-rules/</a>

#### **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: <a href="http://www.cegepmontpetit.ca/ena/a-propos-de-l-ecole/reglements-et-politiques">http://www.cegepmontpetit.ca/ena/a-propos-de-l-ecole/reglements-et-politiques</a>. 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.

#### THE CENTRE FOR ADAPTED SERVICES - FOR STUDENTS WITH DISABILITIES

Students with a professional diagnosis (motor, neurological, organic, sensory, learning, mental health, autism spectrum disorder or other limitations) or with a temporary medical condition may apply for accommodations.

To access this service, send your diagnosis either by MIO to "Service, CSA-ENA" or by email to servicesadaptesena@cegepmontpetit.ca.

If you already have an accommodation plan with the CSA, you are invited to contact your teacher at the beginning of the session to discuss the accommodation measures determined by the CSA.

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