ÉCOLE NATIONALE D'AÉROTECHNIQUE

UNE ÉCOLE AFFILIÉE AU CÉGEP ÉDOUARD-MONTPETIT

280-3D4-EM

FALL 2019

Avionics department

COURSE OUTLINE

COURSE: **Direct-Current Avionics Systems**

PROGRAM: 280.C0 Aircraft Maintenance

DISCIPLINE: 280 Aeronautics

WEIGHTING: Theory: 2 Practica: 2 Personal Study : 2

Your Teacher	Office	☎ extension	✉ e mail or website
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OFFICE HOURS FOR STUDENTS

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Morning					
Afternoon					

Coordinator(s)	Office	☎ extension	✉ e-mail or website
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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)

Distribution of Competence O25T in the program:

►	3rd session	280-3D4-EM: Direct-Current Avionics Systems	55 periods of 100
	4th session	280-4A4-EM: Direct-Current Avionics Systems	30 periods of 100
	6th 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 Competence O263 in the program :

►	3rd session	280-3D4-EM: Direct-Current Avionics Systems	5 periods of 70
	4th session	280-4A4-EM: Direct-Current Avionics Systems	30 periods of 70
	4th session	280-605-EM: Aircraft Instrumentation	5 periods of 70
	6th 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 in a lecture format 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 15 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.	
	3. Explain the effect of electrical field on a charge in space.	
	4 Explain the relationship between electrical field and potential energy of an electric charge.	
	5. Define the concept of electric potential.	
	6. 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.	
	9. Define the concept of electric current.	
	10. Define the quantities used in electricity and identify their units of measure.	
	11. Define the relationship between the electric potential difference, current and electric resistance.	
	12. Identify methods used to produce electrical energy onboard aircraft.	
	13. Describe the characteristics of resistance.	
	14. Identify types of electrical circuits on aircraft.	
	15. Solve a simple circuit made up of two or more resistors, in series and in parallel.	
	16. Solve a mixed circuit (series-parallel)	
	17. Use a multimeter as: voltmeter, ammeter and ohmmeter.	
	18. Check a faulty circuit with a multimeter.	
#2. Verify the direct current	1. 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
of passive components.	2. Check the operation of various control devices used in circuits: - All types of switches - Various types of relays	
	3. Check the operation of various protective devices: temperature, pressure, light and position transducers	
	4. Check the operation of various protective devices.	
	5. Interpret plans and diagrams involving semi-conductor components.	
#3. Verify the direct-current electrical power supply and distribution system of an aircraft.	1. Check the operation of a DC generator	
	2. Check the operation of a D.C. electric motor.	
	3. Check a DC generation system of a single engine piston aircraft	
	4. Check a DC generation system on a single engine turbine aircraft.	
	5. Check a DC distribution system of a single engine piston and a single engine turbine aircraft while respecting safety procedures.	
	6. Diagnose malfunctions in the DC generation and distribution systems of a single engine piston and a single engine turbine aircraft.	
#5. Test the operation of lead-acid batteries.	1. Describe in general the principle of chemical reactions that occur in the lead-acid batteries while charging and discharging.	
	2. Explain the procedure for handling lead-acid batteries.	
	3. Explain the steps in the initial operation of a lead-acid battery.	
	4. Explain the procedure for complete maintenance of a lead-acid battery.	
#7. Determine the charge balance of a direct-current circuit in an aircraft.	1. Identify information relevant to the electrical load analysis for a single engine aircraft: - AC 43 13 - FAR 23 - JAR 23 - Manufacturer's manuals	
	2. 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

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.	1. Make conclusions from chemical reactions regarding inspection methods that cannot be used with nickel cadmium batteries.	
	2. Explain the procedure for handling nickel cadmium batteries.	
	3. Explain the maintenance procedure for a nickel cadmium battery.	

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Session Calendar:

Theory:

Periods		Content		Personal Study	Objectives
Week 1	1 per	Introduction to the course	• Course Outline		
	1 per	Structure of Matter Static Charges	▪ Structure of atoms ▪ Conductors, insulators and semi-conductors ▪ Definition of Coulomb unit ▪ Explanation of the use of static dischargers and bonding braids on an aircraft.	Study: • Chap. 1 (pp. 1-6), chap. 4 (pp. 77-78) and chap. 13 (pp. 261-263) of the reference manual. Homework: • Selected problems to hand in Week 2	#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	▪ Definition of voltage ▪ Sources of voltage ▪ Definition of current ▪ Definition of resistance ▪ Types of resistors used in aircraft circuitry ▪ Common components of an electrical circuit (relay, switch, fuse, lamp) ▪ Identification of a series circuit. Circuits of anti-collision lights, gas levels and others will be explained. ▪ Voltage in a series circuit ▪ Current in a series circuit ▪ Equivalent resistance –series ▪ Power in a series circuit ▪ Laws applied to series circuits ▪ Identification of a parallel circuit. The circuits of navigation lights, landing lights and others will be explained. ▪ Voltage in a parallel circuit ▪ Current in a parallel circuit ▪ Equivalent resistance --parallel ▪ Power in a parallel circuit ▪ Laws applied to parallel circuits ▪ Identification in a mixed circuit of the relationships in series and in parallel ▪ Total current of a mixed circuit; current in the branches. ▪ Equivalent resistance in a mixed circuit ▪ Examples of simple malfunctions in parallel series circuits	Study: • Chap. 2, chap. 6 (pp. 100-102), and chap. 13 (pp. 263-269) of the reference manual. Homework: • Selected problems to hand in Week 5	#1.6 to #1.16 (025T)
Week 5	2 per.	Resistance of a circular lead wire	▪ Resistance of conductors ▪ Types and characteristics of conductors used in aeronautics: AC 43.13-1B and AC 43.13-2A ▪ Definition of a circular mil ▪ Selecting a gage of wire according to the criteria of voltage, current and distance from the source. ▪ Protection devices	Study: • Chap. 4 (pp. 56-66) and chap. 6 (pp. 95-100) of the referrence manual Homework: • Selected problems to hand in Week 6	#2.1 (025T)

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Periods		Content		Personal Study	Objectives
Week 6	2 per.	Semi-conductors	• N, P–type materials, PN junctions and polarization of PN junctions • Recognizing the symbol for diodes (rectifiers) • Functions of diodes - Switching circuits - Free-wheel circuits - LED - photodiodes ▪ Other functions of the diode (Rectifier circuits will be studied in the course 280-404)	Study: • Chap. 6 (pp. 110-113, 121) of the reference manual Homework: • Selected problems to hand in Week 7	#2.5 (025T)
Week 7	2 per	Test 1 (20 points)			#1.1 to #1.16 (025T)
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 : • Chap. 1 (pp. 6-12), chap. 9 (pp. 175-182, 188), chap. 10 (pp. 190-199, 208) and chap. 11 (pp. 210-214) of the reference manual Homework: • Selected problems to hand in Week 11	#2.5 (025T)
Weeks 11 to 13	6 per.	Power generation, distribution and starting systems for piston and turbine single engines.	▪ Using diagrams of a single-engine piston aircraft (Cessna 172 and other examples) make an analysis : - of the power generation and distribution system of electrical energy - of the starter system ▪ Using diagrams of a single-engine turbine aircraft (Bell 206 and other examples) make an analysis of: - the power generation and distribution system of electrical energy - starting system ▪ Explain the electrical load analysis on an aircraft.	Study: • Analyse diagrams of aircraft single-engine pistons and single-engine turbine. Homework: • Review diagrams of aircraft single-engine pistons and single-engine turbine.	#5.1 (025T) #1.1 (0263)
Week 14	2 per.	Batteries	▪ Lead-acid batteries ▪ Nickel-Cadmium Batteries ▪ Principle of chemical reactions	Study: • Chap. 3 of the reference manual Homework: • Selected problems to hand in Week 15 • Theory Review	#2.2 (025T) #2.3 (025T) #2.5 (025T)
Week 15	2 per	Final Test (30 points)			ALL

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Practical Work:

Periods		Content		Personal Study	Objectives
Weeks 1, 2, 3	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 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.	#1.17 (025T) #2.2 (025T) #2.4 (025T)
Week 4	2 per	Presentation and use of the DC simulator (Familiarization with)	A practical presentation of how to use the DC simulator (FR601-M) by the teacher (40 min.) Explanation and demonstration on the operation of a ground power unit used with aircrafts. Students will use the simulator as operators (60 min) to start various systems.	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	2 per	Using the wiring diagram in order to use the Voltmeter and Ohm meter.	- Identifying elements on the diagram - Identifying elements on the simulator - Measuring voltage and resistance on the different elements of the DC simulator (FR601-M). - Troubleshooting (open circuit type failure) a) troubleshooting exclusively with the Ohm meter, b) troubleshooting exclusively with the voltmeter	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.	#1.17 (025T) #1.18 (025T)
Week 6	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 open-circuit 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 7	2 per	Troubleshooting systems Finding defects	Using *14v piston single engine Procedures Manual*. to simulate the context of the individual exam. Open-circuit type failure Systems studied: - Anti-collision - Navigation lights - Landing lights - Fuel level - Fire detection system	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)
Week 8	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 9	2 per	Troubleshooting on aircrafts	In the hangar on a single-engine piston aircraft Explanation and demonstration on the operation of a ground power unit used with aircrafts. Check operation of these elements to detect defects in the systems: -Anti-collision lights -Navigation lights - Landing lights -GPU - Fuel level	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.	#1.18 (025T) #2.5 (025T) #3.3 (025T) #3.4 (025T) #3.5 (025T)
Week 10	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		#3.3 (025T) #1.6 (025T) #1.7 (025T)
Week 11	2 per	Electrical load analysis of a DC system on a single engine airplane	Directed activity: Students are divided into two teams and under the teacher's supervision, achieve static load analysis on two aircrafts.	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.	#5.7.1 (025T) #5.7.2 (025T)
Week 12	2 per	Inspecting power generation and starting system components on an aircraft	In the hangar on a single-engine turbine : Demonstration and inspection : Review inspection procedures for the operation of components to detect defects in the power generation or starting system. Explanation and demonstration of use of the GPU	Laboratory Preparation: Read the corresponding texts in the Course Notes and the Reference Manual Laboratory Reports: Record the activities and measurements taken	#1.18 (025T) #2.5 (025T) #3.3 (025T) #3.4 (025T) #3.5 (025T)

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Week 13	2 per	Demonstration on the maintenance of lead-acid batteries and Troubleshooting exercises	Students will be divided into two groups in the laboratory. Rotation: 1st group (1 period) : - Demonstration by the technician on the maintenance of lead-acid batteries 2nd group (1 period) : - 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	Demonstration on the maintenance of Nickel-Cadmium batteries and Troubleshooting exercises	Students will be divided into two groups in the laboratory. Rotation : 1st group (1 period) : - Demonstration by the technician on the maintenance of Nickel-Cadmium batteries 2nd group (1 period) : - 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.	#1.1 (0263) #1.2 (0263) #1.3 (0263)
Week 15	2 per	Exam on power generation or starter circuit troubleshooting	Individually, students will use the *14V piston single engine Procedures Manual*, 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	One exercise on the objectives	1.1 to 1.7 (025T)	According to MCF and PIEA	Week 3	2%
Quiz	One exercise on the objectives	2.1 (025T)		Week 5	2%
Quiz	One exercise on the objectives	1.1 to 1.16 , 2.1(025T)		Week 11	3%
Quiz	One exercise on the objectives	5.1 (025T) 1.1 (0263)		Week 13	3%
Test 1	Time: 2 periods Individual sheet of formulas (letter format, double-sided, handwritten)	#1.1 to #1.16 (025T)		Week 7	20%
FINAL EXAM FOR THE COURSE	Time: 2 periods Individual sheet of notes (letter format, double-sided, handwritten)	All		Week 15	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: Individual evaluation of laboratory work (75%) : Measurements, handling, interpreting information. Report Evaluation (25%) INDIVIDUAL REPORT	#2.2 (025T) #2.4 (025T)	According to MCF and PIEA Fiarst page of each workshop .	Following week	3%
4. Presentation and use of DC single engine simulator (Familiarization with)		#1.12 (025T) #1.14 (025T)		Following week	3%
5. Using wiring diagrams to use the voltmeter and Ohm meter		#1.17(025T) #1.18 (025T)		Following week	3%
6. Troubleshooting systems		#1.18 (025T) #2.5 (025T) #3.3 (025T) #3.4 (025T) #3.5 (025T)			(Formative)
7. Troubleshooting systems		#1.18 (025T) #2.5 (025T) #3.3 (025T) #3.4 (025T) #3.5 (025T)			(Formative)
8. Troubleshooting Exam	ÉVALUATION 1 (Individual)	#1.18 (025T) #2.5 (025T) #3.3 (025T) #3.4 (025T) #3.5 (025T)		Current week	6%

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9. Inspection of components on an aircraft	Laboratory Work: Individual evaluation of laboratory work (75%) : Measurements, handling, interpreting information. Report Evaluation (25%) INDIVIDUAL REPORT	#3.3 (025T) 1.18 (025T) #2.5 (025T) #3.3 (025T) #3.4 (025T) #3.5 (025T)		Week 10	3%
10. Dischargers and bonding braids Check of an aircraft DC generation system.		#1.6 (025T) #1.7 (025T)		Following week	3% 3%
11. Achieving load balance of a DC system on a single-engine airplane		#5.7.1 (025T) #5.7.2 (025T)		Following week	3%
12. Inspect elements of the power generation and starting systems on an aircraft.	Laboratory Work : Individual evaluation of laboratory work (75%) : Measurements, handling, interpreting information Report evaluation (25%) INDIVIDUAL REPORT	#1.18 (025T) #2.5 (025T) #3.3 (025T) #3.4 (025T) #3.5 (025T)	According to MCF and PIEA Fiarst page of each workshop .	Week 13	3%
13. 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)		Week 15	3%
14. Troubleshooting exercises		#1.18 (025T) #2.5 (025T) #3.3 (025T) #3.4 (025T) #3.5 (025T)			(Formative)
15. Exam on troubleshooting power generation circuit or starting circuit	ÉVALUATION 2 (Individual)	#1.1 (0263) #1.2 (0263) #1.3 (0263) #1.1 (0263)		Current Week	7%

Sub-total: 40%

TOTAL: **100%**

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MEDIAGRAPHY

- EISMIN, THOMAS K. – Aircraft Electricity & Electronics, Fifth Edition, Glencoe, 2002.

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: www.cegepmontpetit.ca/normes.

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: http://guideena.cegepmontpetit.ca/regles-des-departements/

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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:
http://guideena-en.cegepmontpetit.ca/department-rules/

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.

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