

COURSE OUTLINE

COURSE: Radio Systems

PROGRAM: 280.D0 Aircraft Maintenance Technology

DISCIPLINE: 280 Aeronautics

WEIGHTING: Theory: 2 Practical Work: 2 Personal Study : 2

Instructor(s)	Office	☎ extension	✉ Email or Website
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OFFICE HOURS

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Morning					
Afternoon					

Coordinator(s)	Office	☎ Extension	✉ Email or Website
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This course outline is the translation of "Plan de cours – 280-644-EM – Systèmes radio". In case of any contradictions, the French version, which is the original, prevails.

CONTEXT OF THIS COURSE IN THE PROGRAM

This course is offered in the fifth session of the program. It is assumed that students who enroll in the course have passed the courses in their preceding sessions, in particular : DC Avionics (280-3D4), AC Avionics (280-4A4) and Aircraft Instrumentation (280-4C5). Students who do not meet these conditions may still enroll in the course, however the Avionics Department believes that these students will find it more difficult to pass the course.

By the end of the course, students will have developed:

- The ability to explain the general principle of the operation of aircraft radiocommunication and of the intercom system.
- The ability to use technical documents to identify procedures for checking equipment and the appropriate tools for these checks.
- The ability to transmit information about the communications systems in a structured format and using appropriate language.
- The ability to carry out inspection tests, repairs, installations, and removal related to the communication and navigation systems of an aircraft.

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

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

MINISTERIAL OBJECTIVE(S) AND COMPETENCIES

- **0265** – To check the operation of communication, navigation and instrumentation systems.

Students who have passed the courses in the preceding sessions will have acquired Competence 0265 after passing this course.

TEACHING AND LEARNING STRATEGIES

Theory:

The theoretical course will be delivered in a lecture format, and where appropriate and useful, supported by copies of course notes, examples of applications in aircraft maintenance manuals, documentation from radio systems manufacturers, excerpts from reference manuals and multimedia presentations.

Practical Work:

Spread out over 15 laboratory sessions, the acquisition of the material (know-how?) will be facilitated by a series of experiments from basic characteristics of electronic components, removing and installing components in communication systems, to the verification of performance and simple repairs of various types of airborne communication systems.

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COURSE SCHEDULE

Session Calendar:

Theoretical Part:

Periods		Content		Personal Study	Objectives
Week 1	2	Introduction to the course	<ul style="list-style-type: none"> • Course Outline • Introduction to airborne radiocommunication and radionavigation systems • Short presentation of the avionics systems in different airplane and helicopter cockpits 	Review course notes taken in class, reference documents and hand-outs.	0265 #1.1
	Weeks 2 and 3	4	<ul style="list-style-type: none"> • Electromagnetic waves and their properties • Describe the phenomena related to electromagnetic waves. 	<ul style="list-style-type: none"> • Basic principle of radio communications • Nature of electromagnetic waves (EW). • Creation of electromagnetic waves by an electric current <ul style="list-style-type: none"> • Electric field • Magnetic field • Polarization of electromagnetic waves • Propagation speed of electromagnetic waves • Relationship between frequency and wave length • Aeronautical communication and navigation reserved frequency bands • Hazards related to electromagnetic waves • Modes of propagation of electromagnetic waves : <ul style="list-style-type: none"> • Sky waves • Direct waves • Ground waves • Characteristics of different atmospheric layers • Changes in the ionosphere level depending on the season and time of day • Comparison between different modes of propagation and the applications in the aeronautical communications systems. • Properties of HF, VHF, UHF and SHF radio-communication systems. 	Review course notes taken in class, reference documents and hand-outs.
Week 4	15 min.	Closed book mini test (5 points)	<ul style="list-style-type: none"> • 10 multiple choice questions à choix multiples on material covered during Weeks 1 to 3 	Review everything to date (Weeks 1 to 3)	0265 #1.1 and 1.2
	1.75	Antennas and their operating principles	<ul style="list-style-type: none"> • Operation principle of antennas • Effective lengths and shapes of antennas • Effectiveness of antennas • Types of antenna polarization • Choices of installation locations <ul style="list-style-type: none"> ○ Mass and radiation plan ○ Antenna couplers and their uses • Examples of antenna installation on aircrafts • Maintenance and protection of the antennas 	Review course notes taken in class, reference documents and hand-outs.	0265 0265 # 1.3

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Periods		Content	Personal Study	Objectives	
Week 5	4	General principle of operation of aeronautical radio systems	<ul style="list-style-type: none"> • RF Power • Definitions of Bel and decibel • Introduction to basic concepts of radio circuits (qualitative approach): <ul style="list-style-type: none"> • Filters: highpass, lowpass, bandpass, notch (bandstop) • Amplifier circuits . • Oscillator circuits • Synthesizers • Block diagram of a transceiver • Modulation and modulation types used in aeronautics: CW, AM, SSB, FM et PM. 	Review course notes taken in class, reference documents and hand-outs.	0265 #1.1, 1.4 et 1.5
Week 6	2	Logic gates and digital electronics	<ul style="list-style-type: none"> • Basic principles of digital electronics (qualitative approach) <ul style="list-style-type: none"> • Logic state • Combinatorial logic gates. • Sequential logic circuits • Encoding and decoding • Example of decoding BCD to 7 segments 	Review course notes taken in class, reference documents and hand-outs.	0265 #1.7
Week 7	1	Written Exam #1: Closed book (25 points).	<ul style="list-style-type: none"> • Covers all material seen during Weeks 1 to 6. 	Review all material seen to date (Weeks 1 to 7)	0265 # 1.1, 1.2, 1.3, 1.4 and 1,5
Week 7	1	General principle of operation of aeronautical radio systems (continued)	<ul style="list-style-type: none"> • Roles of aeronautical communication systems • Definitions of terms used in radiocommunication • Types of radios used in aerospace • Operation principle of an aeronautical radio <ul style="list-style-type: none"> ○ Transmitter (Transceiver?) ○ Receiver 	Review course notes taken in class, reference documents and hand-outs.	0265 1.1, 1.2, 1.4, 1.5

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Periods		Content	Personal Study	Objectives		
Weeks 8, and 9	3	General principle of operation of aeronautical radio systems (continued)	<ul style="list-style-type: none"> • Operation principle of a VHF-AM transmitter-receiver <ul style="list-style-type: none"> ○ Band frequencies. ○ Separation between channels ○ Number of channels in the reserved range and the evolution of VHF-AM communication ○ Theoretical range of VHF communication • The components in a VHF-AM communication system <ul style="list-style-type: none"> ○ Control console ○ Transceiver ○ Antenna cables ○ Antennas ○ Choice of antennas and locations on the aircraft Regulatory requirements (CARs) and certifications (RTCA, TSO). • Study of an example of a VHF-AM system installed on an aircraft • Emergency radio beacon (ELT) <ul style="list-style-type: none"> ○ Operation ○ Definitions of used terms ○ Types and frequencies used ○ Installation of the transmitter and antenna ○ Check the functionality of the system and periods allowed for checks ○ Regulatory requirements: RAC, OACI. 	Review course notes taken in class, reference documents and hand-outs.	0265 # 1.5	
	Week 9	1	General principle of operation of the intercom system and ancillary systems (PA, entertainment systems, etc.)	<ul style="list-style-type: none"> • On board audio systems: <ul style="list-style-type: none"> ○ Key components in an intercom system and their operation ○ Installation and important points of installation ○ Different types of <ul style="list-style-type: none"> ▪ Microphones, speakers, and headsets ▪ Connectors ▪ Impedances and impedance matching • Other audio systems (PA, entertainment, etc.) • Examples of audio systems (excerpts from aircraft maintenance manuals) • Audio consoles 	Review course notes taken in class, reference documents and hand-outs.	0265 # 1.6
	Week 10	0.25	Closed book mini test (5 points)	<ul style="list-style-type: none"> • 10 multiple choice questions on material seen during Weeks 7 to 9. 	Review all material (Weeks 7 to 9)	0265 # 1.1, 1.2, 1.4, 1.5, 1.6

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Periods		Content	Personal Study	Objectives	
Weeks 10, 11 and 12	5.75	Principles of radionavigation systems	<ul style="list-style-type: none"> • Short range navigation systems (elements) : Systèmes de navigation à courte distance (éléments) : <ul style="list-style-type: none"> • ILS • ADF • VOR • ILS • DME • Satellite navigation systems (GNSS) (elements): <ul style="list-style-type: none"> • GPS. • GLONASS. • Galileo. • Identification and positioning systems and (elements) : <ul style="list-style-type: none"> • Transponder • TCAS. • ADS-B. 		0265 #1.2, 1.4
Week 13	0.25	Closed book mini test (5 points)	<ul style="list-style-type: none"> • 10 multiple choice questions on material seen during Weeks 10 to 12. 	Review all material (Weeks 10 to 12)	0265 # 1.2, 1.4,
Week 13	1.75	Different display types and methods.	<ul style="list-style-type: none"> • Flight data electronic display systems (EFIS and HUDS) <ul style="list-style-type: none"> ○ Operating principle and system interfaces ○ Information and information colour coding • Head-up display systems (HGS/HUDS). • Multi Function Displays - MFD • VEMD system (Vehicle Engine Monitoring Display) • Flight management system interfaces (FMS) 	Review course notes taken in class, reference documents and hand-outs.	0265 # 1.7.
Week 14	2	General principle of operation of the intercom system and ancillary systems (PA, entertainment systems, etc.)	<ul style="list-style-type: none"> • Principle of operation of a HF-AM transceiver <ul style="list-style-type: none"> ○ Band frequencies. ○ Components in the system: <ul style="list-style-type: none"> ▪ Antenna ▪ Antenna coupler ▪ Transceiver ○ Separation between channels ○ Benefits and dangers associated with using HF radio • SELCAL and ACARS Systems <ul style="list-style-type: none"> ○ Operation ○ Programming codes according to the aircraft ○ Studies of an example of an installed SELCAL system ○ Example of an ACARS message • SATCOM System <ul style="list-style-type: none"> ○ Introduction <p>System installation on the aircraft and types of antennas.</p>	Review course notes taken in class, reference documents and hand-outs.	0265 # 1.5
Week 15	2	Final Exam: Closed book (25 points)	Comprehensive written exam for the course. No documents allowed.	Review all material seen in the course (Weeks 1 to 14)	0265 : # 1, # 2, # 3, # 4.

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Practical Part

Periods		Content	Personal Study	Objectives	
Week 1	2 per.	Introduction to the course and review of safety measures	<p><u>Laboratory:</u> Introduction to safety rules and how to work in the laboratory, hangars and runways.</p> <p><u>Hangars (review) :</u> safety measures, GPU and electrostatic connection</p>	<p>Summarize important concepts concerning safety in the laboratory, the hangars and on the runways.</p> <p>Write an individual report that will be handed in at the end of the course.</p>	0265
Week 2	2 per.	Familiarisation with avionics systems installed in general and business aviation	<p><u>Hangars :</u> Identification of radiocommunication and radionavigation systems installed in aircraft at the school</p>	<p>Review elements seen in the theoretical part of the class regarding the setup (implementation, installation) of avionics in aircraft.</p> <p>Write report (individually) to be handed in at the end of the course.</p>	0265 # 2.1 and 5.1.
Week 3	2 per.	Preparation for Restricted Operator's Certificate Exam	<p><u>Laboratory:</u></p> <ul style="list-style-type: none"> o Analysis of difficulties encountered in studying CIR-21 document o Situational radio communication exercises <p>Scenario questionnaire</p>	<p>Study CIR-21 document distributed by Industry Canada</p> <p>In-class correction of the scenario questionnaire</p>	0265 # 2.3.
Week 4	2 per.	License Exam to obtain the Restricted Operator's Certificate with Aeronautical Qualification		<p>The mark for this class as well as the preceding class, will be determined by the mark obtained on the Industry Canada exam.</p>	0265 # 2.3.
Week 5	2 per	Verifying principles and characteristics of an antenna EMW	<p><u>Laboratory:</u></p> <ul style="list-style-type: none"> o Length of an antenna depending on the frequency o Impedance adaptation o Grounding of a Marconi antenna 	<p>Write report (individually) to be handed in at the end of the course.</p>	

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Periods		Content	Personal Study	Objectives	
Week 6	2 per..	Identification of aircraft antennas	<u>Hangars:</u> Antenna identification: <ul style="list-style-type: none"> o COM (VHF) o HF o ELT o ADF o VOR-LOC-GS o DME o MKR o GPS o Transponder. o Weather Radar 	Write report (individually) to be handed in at the end of the course.	0265 # 2.1.
Week 7	2 per.	Removing and installing of radios, identifying their types, their models, their locations and their serial numbers.	<u>Hangars:</u> Learn techniques of removal and installation of avionics equipment (Allen wrench, chassis components, Dzus fasteners)	Write report (individually) to be handed in at the end of the course.	0265 # 3.1 and 5.1.
Week 8	2 per.	Antenna installation (On a metal plaque).	<u>Laboratory:</u> <ul style="list-style-type: none"> o Check knowledge on the use of hazardous materials (CRP) o Learn techniques for installing antennas 	Review WHMIS symbols and regulations Written report (individually) handed-in at the end of the course	0265 # 4.1, 4.2 and 5.1.
Week 9	4 per.	Introduction to FMS systems.	At 438 Squadron and hangars – theoretical and practical information on the AMS of Bell CH-146 Griffon of RCAF	Written report (individually) handed-in at the end of the course	0265 # 2.1, 2.2, 4.1. 4.2 and 5.1.
Week 10	1 per	EFIS operation demonstration	<u>Laboratory - EFIS mock-up:</u> <ul style="list-style-type: none"> o Analyse EFIS system operation o Validate displayed data compared to input signals. o Verify data and image transfer between displays. 	Review knowledge on short range navigation Written report (individually) handed-in at the end of the course	0265 # 2.1, 2.2, 4.1. 4.2 and 5.1.

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Periods		Content	Personal Study	Objectives	
Week 11	2 per.	Installing and testing audio systems (by students).	<u>Laboratory:</u> <ul style="list-style-type: none"> ○ Make a simple installation of an intercom system using didactic elements ○ Check installation ○ Troubleshoot simple breakdowns ○ Identify microphone lines using a multimeter. 	Review material on audio systems. Written report (individually) handed-in at the end of the course.	0265 # 4.1, 4.2, and 5.1.
	Weeks 12 to 14	2 per.	Identify the locations of the ELT distress beacons on different types of aircraft and carry out a test on them. (rotation, 1 of 3, part 1)	<u>Hangars:</u> <ul style="list-style-type: none"> ○ Check the location of the ELT beacons on different planes and helicopters. ○ Open a job card for a test ○ Perform a test (demonstration by the teacher). ○ Write final version of job card ○ Prepare ELT beacon for shipping 	Review required regulations (CAR) Written report (individually) handed-in at the end of the course.
			Testing radiocommunication systems (rotation, 1 of 3, part 2)	<u>Hangars:</u> <ul style="list-style-type: none"> ○ Test VHF-COM systems and audio console. ○ Use of walkie-talkie by students (restricted operator's certificate mandatory) 	Review material on radiocommunication (individual evaluation of knowledge by the instructor) Test sheets and job cards to hand in at the end of the course.

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Periods		Content	Personal Study	Objectives	
Weeks 12 to 14	2 per.	Testing radionavigation systems (rotation, 2 of 3)	<u>Hangars:</u> <ul style="list-style-type: none"> ○ Test VOR, ILS, CDI, HSI systems and audio console. ○ Use of TIC T30D portable testers by students 	Review material on radionavigation (individual evaluation of knowledge by the instructor) Test sheets and job cards to hand in at the end of the course.	0265 # 2.1, 2.2, 3.1, 4.1, 4.2 and 5.1.
	2 per	Testing radionavigation and identification systems (rotation, 3 of 3)	<ul style="list-style-type: none"> ○ Test transponder system (mode A and C) and DME. ○ Use of TR220 portable testers by students 	Review material on radionavigation and identification systems (individual evaluation of knowledge by the instructor) Test sheets and job cards to hand in at the end of the course.	0265 # 2.1, 2.2, 3.1, 4.1, 4.2 and 5.1.
Week 15	2 per.	Review of the FMS system and the EFIS displays on CL601	<u>Hangars:</u> <ul style="list-style-type: none"> ○ Research on the EFIS test to be performed ○ Operation demonstration on the Challenger CL601 	Questionnaire to be answered at the end of the class	0265 # 4.1, 4.2, and 5.1.

ROTATION LABS SCHEDULE

Week	LAB # 1/3	LAB # 2/3	LAB # 3/3
12	team 1	team 2	team 3
13	team 3	team 1	team 2
14	team 2	team 3	team 1

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SYNTHESIS OF SUMMATIVE EVALUATION METHODS

Theory⁽¹⁾

Description of Evaluation Activity	Context	Learning Objective(s)	Due Date (date assignment is due or exam given)	Weighting (%)
Mini test 1 (15 minutes--maximum)	Written test of 10 multiple choice questions	0265 #1.1 and 1.2	Week 4	5 points
Exam 1 (1 hour)	Written Exam	0265 # 1,1, 1.2, 1.7 and # 2.1	Week 7	20 points
Mini test 2 (15 minutes--maximum)	Written test of 10 multiple choice questions	0265 # 1.5	Week 10	5 points
Mini test 3 (15 minutes--maximum)	Written test of 10 multiple choice questions	0265 # 1.2, 1.4	Week 13	5 points
Exam 2 (2 hours)	Written Exam	All objectives	Week 15	25 points

Sub-total : 60

Practical Work⁽²⁾

Description of Evaluation Activity	Context	Learning Objective(s)	Due Date (date assignment is due or exam given)	Weighting (%)
Introduction to the course and review of safety measures	Individual report	0265 # 2.1 and 5.1.	At the end of class	2 points.
Familiarisation with avionics systems installed in general and business aviation	Individual report	0265 # 1.2, 2.1 and 4.1.	At the end of class	3 points.
Radiotelephone license test—aeronautical category.	Industry Canada Exam	265 # 2.3.	During the class for Week 5	5 points
Antenna and EMW principles and characteristics	Individual report	0265 # 1.1, 1.2, 1.3	At the end of class	2 points
Identifying aircraft antennas.	Individual report	0265 # 2.1.	At the end of class.	3 points.
Removing and installing radios, identifying their types, models, locations and serial numbers.	Individual report	0265 # 3.1 and 5.1.	At the end of class	3 points.
Antenna installation	Check knowledge about WHMIS (questionnaire, 5 questions).	0265 # 4.1, 4.2 and 5.1.	At the beginning of the class – week 8	1 point.

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	Practical work : install following standards, taking care to assure sealing joint		At the end of the class – week 8.	2 points.
Introduction to FMS systems.	Individual report	0265 # 2.1, 2.2, 4.1. 4.2 and 5.1.	At the end of class – week 9	2 points.
Quiz on EFIS	Individual questionnaire	0265 # 2.1, 2.2, 4.1. 4.2 and 5.1.	At the end of class – week 10	2 points
Installing and testing audio system	Before class preparation Individual report	0265 # 2.1, 2.2, 4.1, 4.2 and 5.1.	Written preparation at the beginning of the class – week 11 At the end of the class – week 11	3 points.
Identifying locations of ELT distress beacons on different types of aircraft and performing a test on them (1/3 part 1)	Test ELT knowledge (questionnaire, 3 questions).	0265 # 2.1, 2.2, 4.1, 4.2 and 5.1.	At the beginning of class – weeks 12, 13, 14	1 point.
	Individual report		At the end of class – weeks 12, 13, 14	1 point.
Testing radiocommunication systems. (1/3 part 2)	Individual report, test sheets and job cards	0265 # 2.1, 2.2, 3.1, 4.1, 4.2 and 5.1.	At the end of class – weeks 12, 13, 14	2 point.
Testing radionavigation systems. (2/3)	Individual report, test sheets and job cards	0265 # 2.1, 2.2, 3.1, 4.1, 4.2 and 5.1.	At the end of class – weeks 12, 13, 14	3 points
Testing radionavigation and identification systems. (3/3)	Individual report, test sheets, job cards	0265 # 2.1, 2.2, 3.1, 4.1, 4.2 and 5.1.	At the end of class – weeks 12, 13, 14	3 points.
Review on FMS and EFIS on CL601	questionnaire	0265 # 2.1, 2.2, 4.1, 4.2 and 5.1.	During class – week 15	2 points

Sub-total : 40

TOTAL : 100

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| <p>(1) The exams are written exams for which students must solve circuits using mathematical developments. These exams may also include multiple choice questions.</p> <p>(2) In order for a report to be corrected, students must be present for the corresponding activities. Any student who is absent for an activity or a part of an activity will receive a zero (0) for the report corresponding to this activity or the part of the activity missed. If the absence is for a serious reason, the student will not be penalized for this activity or part of the activity.</p> |
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REQUIREMENTS TO PASS THE COURSE

(1) Passing Mark

A passing mark is 60%.

(2) Course Attendance for Summative Evaluations

Students must be present for summative evaluations.

(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 work day it is late. On the sixth day after the due date, the assignment will receive a zero (0).

(4) Presentation of Written Work

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

(5) Quality of the English language

The Instructor supports the use of the exact English terminology.

The formative evaluation also relates to the quality of oral and written English. If need be, the instructor recommends to the students to register for an English course.

When a given homework is considered to be unacceptable because of the quality of written English, the correction of this work will be delayed until work is returned in the standards set by the instructor. In this case, the homework handing-over delays penalties apply.

The professor can allocate 10% of the mark for a work to the quality of oral or written English.

CLASS PARTICIPATION EXPECTATIONS

Laboratory safety and use of the premises:

Students must be under the supervision of an instructor 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 instructor and then be excluded from the laboratory until the case can be reviewed by the instructor and the coordinator of the Avionics Department.

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REQUIRED MATERIAL

- Safety equipment complying to ENA rules

Students must use the mounting plate and the components that were given to them during the first session. All other required equipment for the course will be provided by the school.

MEDIAGRAPHY

Required texts

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

Course documents (theory and laboratory) are available on LÉA or on the instructor's website

Canadian aviation regulations: available on the website for Transport Canada (<http://www.tc.gc.ca/fra/lois-reglements/reglements-dors96-433.html>).

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 Cégep web site at the following address: <http://ena.cegepmontpetit.ca/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.

OTHER DEPARTMENTAL REGULATIONS

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

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