

## COURSE OUTLINE

**COURSE:** Helicopters

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

**DISCIPLINE:** 280 Aeronautics

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

Instructor(s)	Office	☎ extension	✉ email or web site
Rancourt Serge	C-182	4664	<a href="mailto:serge.rancourt@cegepmontpetit.ca">serge.rancourt@cegepmontpetit.ca</a>

### OFFICE HOURS

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Morning					
Afternoon					

Coordinator(s)	Office	☎ extension	✉ e-mail or web site
Dany Charette	B-125	4661	<a href="mailto:dany.charette@cegepmontpetit.ca">dany.charette@cegepmontpetit.ca</a>
Louis Guimont	B-125	4703	<a href="mailto:louis.guimont@cegepmontpetit.ca">louis.guimont@cegepmontpetit.ca</a>

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

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

The basic knowledge students acquire in this course is essential for any future work regarding helicopters.

It is also RECOMMENDED that students complete this course before signing up for an internship during the 5<sup>th</sup> or 6<sup>th</sup> sessions.

The overall objective of the course is to apply the principles of aerodynamics to flying and maintaining a helicopter.

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

### **Transport Canada**

This course outline meets the requirements of Training Organisation Certification Manual (MCF) of Transport Canada.

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

## **MINISTRY OBJECTIVE(S) AND COMPETENCIES**

**0268** To apply principles of aerodynamics to flight and helicopter maintenance.

## **TEACHING AND LEARNING STRATEGIES**

### **Theory:**

This part of the course includes seven modules covering basic concepts in aeronautics, aerodynamics and helicopters.

Formal lectures will be supported with examples, exercises, illustrations, animations and equipment. Students will complete their learning with their course notes.

### **Practical Work:**

The practical part is divided into ten chapters that deal with nomenclature and various mechanical aspects specific to helicopters. For this part of the course, simulation exercises, plenary sessions, demonstrations, identification exercises and handling will be used.

**COURSE PLAN – THEORY**

**0268** To apply principles of aerodynamics to flight and helicopter maintenance.

**Activity Periods:** 3 hours (approximately)

**MODULE 1 – BASIC CONCEPTS**

Learning Objective	Content	Personal Study Activities
1.2 Recognize the nomenclature related to forces, velocity, moments, torque, axes, planes and angles (Review of 280-265-EM)	<ul style="list-style-type: none"> <li>▪ Engines, materials, gyroscopic precession, change in pitch, buffeting, lead and lag, swash plate, anti-torque system, history of the evolution of helicopters</li> </ul>	Course Notes

**Activity Periods:** 5 hours (approximately)

**MODULE 2 – STARTING**

Learning Objective	Content	Personal Study Activities
1.4 Precisely distinguish the factors that influence: drag, lift, tilt, stability and performance.	<ul style="list-style-type: none"> <li>▪ Change in tangential velocity (<math>U = 2\pi RN</math>) along a rotating blade.</li> <li>▪ Importance of centrifugal force (<math>F_c = M\omega^2R</math>) exerted on a rotating blade.</li> <li>▪ Construction of a blade</li> <li>▪ Air Resistance (<math>R = \frac{1}{2}\rho U^2SK</math>) on a rotating blade</li> </ul>	Course Notes

**Activity Periods:** 4 hours (approximately)

**MODULE 3 – TAKE-OFF**

Learning Objective	Content	Personal Study Activities
1.3 Apply the formulas and equations relating to the principles of aerodynamics.	<ul style="list-style-type: none"> <li>▪ Change in differential pressure produced by a rotating blade.</li> <li>▪ Impact and solutions of the variation in resultant aerodynamic force (<math>F_r = \frac{1}{2}\rho v^2 S C_r</math>) along a blade (vertical bending) and the blades assembly (conicity, axes, planes, angles)</li> <li>▪ Balance of forces and ground effect while hovering</li> </ul>	Course Notes
1.4 Precisely distinguish the factors that influence: drag, lift, tilt, stability and performance.		

**Activity Periods: 10 hours (approximately)**

**MODULE 4 – HORIZONTAL FLIGHT**

Learning Objective	Content	Personal Study Activities
1.4 Precisely distinguish the factors influencing: drag, lift, tilt, stability and performance.	<ul style="list-style-type: none"> <li>▪ Changing the orientation of the resultant aerodynamic force to gain movement and combat parasites.</li> <li>▪ Gyroscopic precession phenomenon</li> <li>▪ Source and solutions of the reaction torque of the main rotor</li> <li>▪ Flight controls</li> </ul>	Course Notes
1.5 Explain the principles and phenomena related to helicopter flight.	<ul style="list-style-type: none"> <li>▪ Effect and solution of the lateral dissymetry of lift</li> <li>▪ Buffeting effect of the blades (Coriolis forces)</li> <li>▪ Solutions for horizontal bending moments</li> <li>▪ Types and arrangements of the main rotors</li> <li>▪ Balance of forces present</li> </ul>	

**Activity Periods: 4 hours (approximately)**

**MODULE 5 – AUTOROTATION**

Learning Objective	Content	Personal Study Activities
2.2 Explain the settings in an autorotation system	<ul style="list-style-type: none"> <li>▪ Definition of autorotation</li> <li>▪ Autorotative and anti-autorotative forces</li> <li>▪ Change in angle of attack along a blade in autorotation</li> <li>▪ Autorotation and anti-autorotation range</li> <li>▪ Influence of the speed during horizontal flight on the autorotative zone</li> <li>▪ Control of the rotor speed in autorotation</li> </ul>	Course Notes

**Activity Periods: 2 hours (approximately)**

**MODULE 6 – LES PERFORMANCES**

Learning Objective	Content	Personal Study Activities
2.3 Carry out a performance check of a turbine engine on a helicopter	<ul style="list-style-type: none"> <li>▪ Stall and compressibility</li> <li>▪ Powers</li> </ul>	Course Notes

**Activity Periods: 2 hours (approximately)**

**MODULE 7 – RETOUR AU SOL : L'ATTERRISSAGE ET L'HISTORIQUE**

Learning Objective	Content	Personal Study Activities
3.2 Explain the basic principles of vibration and its effects.	<ul style="list-style-type: none"> <li>▪ Causes of and solutions for ground resonance</li> <li>▪ Variation in the sources and intensity of vibration</li> <li>▪ Solutions to the problems of vibration</li> <li>▪ Steps and pitfalls that pioneers in the development stages confronted regarding the principles of aeronautics for rotorcraft.</li> </ul>	Course Notes
3.3 Explain the types and causes of vibration		
3.4 Explain devices for vibration suppression.		
1.1 Recognize the main stages in the evolution of rotorcraft.		

**COURSE PLAN – THEORY**

**0268** To apply principles of aerodynamics to flight and helicopter maintenance.

**Activity Periods: 6 hours (approximately)**

**Introduction – Basic Concepts**

Learning Objective	Content	Personal Study Activities
1.1 Recognize the main stages of the evolution of rotorcraft.	<ul style="list-style-type: none"> <li>▪ The history of helicopters</li> <li>▪ Nomenclature of the components of a helicopter</li> </ul>	<ul style="list-style-type: none"> <li>▪ Course Notes</li> </ul>
3.1 Recognize the safety rules related to walking around a running helicopter	<ul style="list-style-type: none"> <li>▪ Safety rules</li> </ul>	

**Activity Periods: 2 hours**

**CHAPTER 1: Propulsion**

Learning Objective	Content	Personal Study Activities
2.3 Carry out a performance check of a turbine engine on a helicopter	<ul style="list-style-type: none"> <li>▪ Types of engines used</li> <li>▪ Components made for engines so that they can operate on helicopters</li> <li>▪ Checking engine performance</li> </ul>	<ul style="list-style-type: none"> <li>▪ Course Notes</li> </ul>

**Activity Periods: 3 hours**

**CHAPTER 2: Landing Gear    CHAPITRE 3: Structures    CHAPITRE 4: Bearings**

Learning Objective	Content	Personal Study Activities
2.1 Explain the operation of the various elements of the mechanical drive.	<ul style="list-style-type: none"> <li>▪ Possible types of landing gear for helicopters</li> <li>▪ Different structures and construction modes</li> <li>▪ Evolution of the bearings and their distinct functions</li> </ul>	<ul style="list-style-type: none"> <li>▪ Course Notes</li> </ul>

**Activity Periods: 2 hours**

**CHAPTER 5: Blades**

Learning Objective	Content	Personal Study Activities
1.1 Recognize the main stages of the evolution of rotorcraft.	<ul style="list-style-type: none"> <li>▪ Evolution of the main rotor blades and the tail rotor</li> <li>▪ Materials used</li> <li>▪ Construction of the blades</li> <li>▪ Shape and number of blades</li> <li>▪ Eccentricity</li> </ul>	<ul style="list-style-type: none"> <li>▪ Course Notes</li> </ul>

**Activity Periods: 2 hours**

**CHAPTER 6: Flight and Lift Controls**

Learning Objective	Content	Personal Study Activities
2.1 Explain the operation of the different elements of the mechanical chain.	<ul style="list-style-type: none"> <li>▪ Flight controls</li> <li>▪ Swashplate</li> <li>▪ Variation in collective and cyclic pitch control</li> </ul>	<ul style="list-style-type: none"> <li>▪ Course Notes</li> </ul>

**Activity Periods: 4 hours**

**CHAPTER 7 : Rotor Heads**

Learning Objective	Content	Personal Study Activities
1.2 Recognize the nomenclature related to force, velocity, moment, torque, axes, planes and angles.	<ul style="list-style-type: none"> <li>▪ Articulated rotors</li> <li>▪ Semi-articulated rotors</li> <li>▪ Rigid rotors</li> <li>▪ Semi-rigid rotors</li> <li>▪ Lead-lag motion</li> <li>▪ Flapping motion</li> <li>▪ Change in pitch</li> </ul>	<ul style="list-style-type: none"> <li>▪ Course Notes</li> </ul>

**Activity Periods: 3 hours (approximately)**

**CHAPTER 8 : Les systèmes anti-couple**

Learning Objective	Content	Personal Study Activities
2.1 Explain the operation of different elements of the mechanical chain	<ul style="list-style-type: none"> <li>▪ Conventional tail rotors</li> <li>▪ K-link</li> <li>▪ Pitch change mechanism.</li> <li>▪ Fenestron</li> <li>▪ Intermeshing rotors</li> </ul>	<ul style="list-style-type: none"> <li>▪ Course Notes</li> </ul>

**Activity Periods: 2 hours (approximately)**

**Soufflerie**

Learning Objective	Content	Personal Study Activities
1.4 Precisely distinguish the factors influencing: drag, lift, tilt, stability and performance.	<ul style="list-style-type: none"> <li>▪ Centrifugal force</li> <li>▪ Lift</li> <li>▪ Disc and cone rotor</li> <li>▪ Effects of the changes in relative wind on the blades</li> </ul>	<ul style="list-style-type: none"> <li>▪ Course Notes</li> </ul>

**Activity Periods: 2 hours (approximately)**

**CHAPTER 9 : La chaîne mécanique et l'autorotation**

Learning Objective	Content	Personal Study Activities
2.1 Explain the operation of the various elements of the mechanical chain	<ul style="list-style-type: none"> <li>▪ Drive shafts</li> <li>▪ Tail rotor drive shaft</li> <li>▪ Sprag clutch</li> <li>▪ Autorotation and blade inertia</li> </ul>	<ul style="list-style-type: none"> <li>▪ Course Notes</li> </ul>
2.2 Explain the settings in the autorotation system.		

**Activity Periods: 2 hours (approximately)**

**CHAPTER 10 : Le contrôle des vibrations**

Learning Objective	Content	Personal Study Activities
3.4 Explain the devices for suppressing vibration	<ul style="list-style-type: none"> <li>▪ Introduction to vibration</li> <li>▪ Source of vibration on helicopters</li> <li>▪ Demonstration of some mechanical means designed by various helicopter manufacturers to reduce vibration</li> </ul>	<ul style="list-style-type: none"> <li>▪ Course Notes</li> </ul>

**Activity Periods: 2 hours**

**CHAPTER 12 : Équilibrage statique d'un rotor semi-rigide**

Learning Objective	Content	Personal Study Activities
<p>1.2 Recognize the nomenclature related to force, velocity, moment, torque, axes, planes and angles.</p> <p>1.6 Distinguish different appropriate methods of rotors adjustment.</p> <p>3.2 Explain the basic principles of vibration and its effects.</p> <p>3.3 Explain the types and causes of vibration.</p> <p>3.5 Explain the requirements, analysis and corrections regarding tracking and balancing blades.</p>	<ul style="list-style-type: none"> <li>▪ Implementing procedures</li> <li>▪ Alignement and static balance</li> <li>▪ String method</li> <li>▪ Introduction to vibration analysis on rotating rotors</li> </ul>	<ul style="list-style-type: none"> <li>▪ Course Notes</li> </ul>

**SYNTHESIS OF SUMMATIVE EVALUATION METHODS**

**Theoretical Part**

Description of Evaluation Activity	Context	Learning Objective(s)	Due Date (approximate date assignment due or exam given)	Weighting (%)
Written exam	Individually, without course notes	See Modules 1, 2, 3 and part of 4.	5 <sup>th</sup> ou 6 <sup>th</sup> week	20%
Written exam	Individually, without course notes	See Module 4.	11 <sup>th</sup> week	20%
Written exam	Individually, without course notes	See Modules 5, 6 and 7.	15 <sup>th</sup> week	20%

**Sub-total : 60%**

**Practical Part**

Description of Evaluation Activity	Context	Learning Objective(s)	Due Date (approximate date assignment due or exam given)	Weighting (%)
Written exam	Individually, without course notes	See introduction and Chapters 1, 2, 3, 4.	6 <sup>th</sup> week	10%
Written exam	Individually, without course notes	See Chapters 5, 6, 7 and 8	11 <sup>th</sup> week	10%
Presentation of student projects.	In teams of 2 or 3.	All	12 <sup>th</sup> week	10%
Written exam	Individually, without course notes	See Chapters 9, 10, 12 and "wind tunnel".	15 <sup>th</sup> week	10%

**Sub-total : 40%**

**TOTAL : 100%**



## **REQUIREMENTS TO PASS THE COURSE**

### **(1) Passing Mark**

The passing mark for this course is 60%.

### **(2) Attendance for Summative Evaluations**

Attendance at summative evaluation activities is mandatory. Students must comply with the requirements for carrying out evaluation activities assigned by the instructor(s) and written in the course outline.

Students who arrive late to a summative evaluation activity may be denied the right to participate in the activity by the instructor.

Any absence from a summative evaluation activity that is not excused for serious reasons (illness, death in the family, critical situation, etc) could result in a zero (0) for that activity.

It is the student's responsibility to meet with the instructor(s) before the evaluation activity or immediately after returning to ENA to explain the reasons for the absence and provide supporting documents (medical certificate, death certificate, subpoena for court appearance, etc). **If the instructor recognizes that the reasons are serious**, arrangements for a postponed exam will be made between the teacher and the student.

### **(3) Submitting Assignments**

The instructor will determine the conditions for submitting assignments and students must respect these conditions.

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

### **(4) Presentation of Written Work**

The instructor will provide students with information and instructions for the proper presentation, content and organization of the work. Any work that is considered unacceptable due to presentation must be resubmitted and will be considered late until it meets the standards established by the instructor. In this case, the penalties for late work apply.

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 centre on the Cégep web site <http://ena.cegepmontpetit.ca/liens-eclair> under the heading **Liens éclair, Bibliothèques, « Aide »**.

## **CLASS PARTICIPATION EXPECTATIONS**

### **In class, in a workshop or in a hanger:**

- Food, drinks, cellphones, pagers, MP3 players, ipods, cameras and any other similar devices are prohibited.

### **In a workshop or in a hanger:**

- ENA coveralls and safety footwear are MANDATORY. Students who do not have them will be refused access to the workshop or hangar and receive an absence in their file.
- Safety glasses are MANDATORY for working on the windtunnels and must be at hand in the hangars.
- Students may not be around the aircraft or use equipment without authorization from the instructor and they must follow instructions carefully
- It is prohibited to climb on a stool, a table or a workbench.
- There must never be more than 3 students per team unless specifically instructed by the teacher and there must never be more than one team per workbench or aircraft.
- Students must clean the workbench and put equipment away after use. In short, they ensure that the room is clean and well organized.

### **In the hangars:**

It is prohibited:

- to bring briefcases, towels, notebooks or backpacks
- to walk around the hangars without authorization from the instructor;
- to go to another hanger without permission from the instructor;
- to use the circular staircases
- to place a notebook or any other object on the wings or any other extremity of the planes;
- to light a flame (e.g. lighter, matches);
- to touch the propellers;
- to open doors and aircraft cowling;
- to touch handles, buttons, switches and controls on an aircraft. Respect the information written on the maintenance labels;
- to congregate;
- to disturb students from another course who are working on an aircraft.
- Only the teacher can lock and unlock the doors of an aircraft. Never force the opening or closing of doors. Handle them with care.
- If a plane is on jacks, do not shake it unnecessarily. Furthermore, be careful.
- Never jump when coming down from an aircraft.
- It is the responsibility of the students to complete exercises on time.
- Once the allotted time has passed, students MUST return to class.
- Compliance with safety and work instructions is not optional; it is MANDATORY.

## **REQUIRED MATERIAL**

- Course Notes: Theory (the instructor will provide the number during the first course).
- Course Notes: Practical Work (the instructor will provide the number during the first course).
- The only calculator that is authorized for exam periods is the SHARP EL 531 model.

## **MEDIAGRAPHY**

LEFORT, Pierre et Hamann J. L'hélicoptère: théorie et pratique, Lyon, Chiron, 1983, 303 pages.  
Réf. : 629.13335 L 494 h

RALETZ, Roger. Théorie élémentaire de l'hélicoptère, Suresne, Aérospatiale Hélicoptère, 1983, 73 pages.  
Réf. : 629.13335 R 163 T

SCHAFER, Joseph. Basic Helicopter Maintenance, Basin Wyo., Aviation Maintenance, © 1980, 343 pages. Réf. : 629.1346 S 296 b

## **OR**

SCHAFER, Joseph. Helicopter Maintenance, Jeppesen Sandersen.

### **Videos:**

*The story of the helicopter*, 629.13335209 S887.

*Rotor et son royaume*, 629.133352 R848.

*Vertical flight*, 629.13A958 V. 11 Ex. 2

*Les missions d'hélicoptère*, 629.13335 P724m.

*Manipulation prévol d'hélicoptère*, disponible à la bibliothèque.

## **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 d'admission et chemine scolaire, la Politique relative à l'usage, à la qualité et à la 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://ena.cegepmontpetit.ca/>

<http://guideena-en.cegepmontpetit.ca/departement-rules/>

**NOTE:** This Course Outline is a translation of the *Plan de cours* for 280-424-EM: *Hélicoptère*. If there is a disparity between the two versions, the original French version will be considered the official version for legal purposes.