

## 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 Website
Serge Rancourt	C-160	4664	<a href="mailto:serge.rancourt@cegepmontpetit.ca">serge.rancourt@cegepmontpetit.ca</a>

### OFFICE HOURS FOR STUDENTS

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Morning					
Afternoon					

Dep. Coordinator(s)	Office	☎ Extension	✉ Email or Website
Éric Goudreault	C-160	4691	<a href="mailto:eric.goudreault@cegepmontpetit.ca">eric.goudreault@cegepmontpetit.ca</a>
Serge Rancourt	C-160	4664	<a href="mailto:serge.rancourt@cegepmontpetit.ca">serge.rancourt@cegepmontpetit.ca</a>

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

This course is offered during the program's fourth semester.

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.**

**Transports 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 ».

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

To master scientific bases and aeronautic maintenance work technics.

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

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

## **TERMINAL OBJECTIVE OF THE COURSE (FINAL COURSE OBJECTIVE)**

- To establish links between the principles of aerodynamics and the various components of a helicopter.

## **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 nine 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:** 4 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 on a rotating blade.</li> <li>▪ Importance of centrifugal force exerted on a rotating blade.</li> <li>▪ Construction of a blade and material used.</li> <li>▪ Shapes and blade quantity.</li> <li>▪ Air resistance 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 related 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 along a blade (vertical bending) and the blades assembly (conicity, axes, planes, angles)</li> <li>▪ Forces equilibrium and ground effect while hovering</li> </ul>	Course Notes
1.4 Precisely distinguish the factors that influence: drag, lift, tilt, stability and performance.		
2.1 Explain the functioning of the various elements of the drive train.	<ul style="list-style-type: none"> <li>▪ Conventional tail rotors.</li> <li>▪ Delta hinge.</li> <li>▪ Pitch change mechanism.</li> <li>▪ Fenestron.</li> <li>▪ Rotor</li> <li>▪ Tandem systems.</li> </ul>	Course Notes

**Activity Periods: 8 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 dissymmetry of lift.</li> <li>▪ Buffeting effect of the blades (Coriolis effect)</li> <li>▪ Solutions for horizontal bending moments</li> <li>▪ Types and arrangements of the main rotors</li> <li>▪ Balance of forces present</li> <li>▪ Eccentricity</li> </ul>	

**Activity Periods: 3 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> <li>▪ Autorotation and blade inertia</li> </ul>	Course Notes

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

**MODULE 6 – ENGINE 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: 1 hours (approximately)**

**MODULE 7 – LANDING AND HISTORY**

Learning Objective	Content	Personal Study Activities
1.1 Recognize the main stages in the evolution of rotorcraft.	<ul style="list-style-type: none"> <li>▪ Main and tail rotor blade evolution</li> <li>▪ Steps and pitfalls that pioneers in the development stages confronted regarding the principles of aeronautics for rotorcraft.</li> </ul>	Course Notes

**COURSE PLAN – LABORATORY**

**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 rotorcraft evolution main stages. 2.1 Explaining the operation of various elements of the mechanical chain. 3.1 Recognize the safety rules related to walking around a running helicopter.	<ul style="list-style-type: none"> <li>▪ The history of helicopters</li> <li>▪ Nomenclature of the components of a helicopter.</li> <li>▪ Flight controls.</li> <li>▪ Swashplate.</li> <li>▪ Collective and cyclic pitch change.</li> <li>▪ Safety rules</li> </ul>	<ul style="list-style-type: none"> <li>▪ Course Notes</li> </ul>

**Activity Periods: 2 hours**

**CHAPTER 1: Landing gear**

**CHAPTER 2 : Fuselage**

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

**Activity Periods: 2 hours**

**CHAPTER 3 : Engines**

Learning Objective	Content	Personal Study Activities
2.3 Perform a turbine engine power check.	<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: 6 hours**

**CHAPTER 4 : Work stations**

**Activity Periods: 2 hours**

**CHAPTER 5 : Powertrain and 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> </ul>	<ul style="list-style-type: none"> <li>▪ Course Notes</li> </ul>

**Activity Periods: 4 hours**

**CHAPTER 6 : Helicopter pre-flight**

Learning Objective	Content	Personal Study Activities
3.1 Recognize the safety rules around running helicopters	<ul style="list-style-type: none"> <li>▪ Safety rules.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Course Notes</li> </ul>

**Activity Periods: 6 hours**

**CHAPTER 7 : Semi rigid rotor static balancing CHAPTER 8 : Main rotor dynamic balancing**

Learning Objective	Content	Personal Study Activities
1.2 Recognize the nomenclature related to force, velocity, moment, torque, axes, planes and angles.  1.6 Distinguish different appropriate methods of rotors adjustment.  3.2 Explain the basic principles of vibration and its effects.  3.3 Explain the types and causes of vibration. 3.4 Explain the vibration suppression features.  3.5 Explain the requirements, analysis and corrections regarding tracking and balancing blades.	<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> <li>▪ Vibration simulator SIMENA</li> </ul>	<ul style="list-style-type: none"> <li>▪ Course Notes</li> </ul>

**SYNTHESIS OF SUMMATIVE EVALUATION METHODS**

Activity Evaluation Description	Learning context and method of evaluation	Learning Objective(s)	Evaluation Criterias	Due Date (approximate date assignment due or exam given)	Weighting (%)
Written exam no.1 Start, take off , horizontal flight and hovering.	Individually, without course notes Duration : 2hours	Learning objectives: 1.2; 1.4; 1.3 and 1.5 Learning objectives: 1.1; 2.1; 3.1	<b>1</b>	6 <sup>th</sup> week of theory course	<u>Theory :</u> 20% <u>Laboratory :</u> 10% <b>Total :</b> <b>30%</b>
Written exam no. 2 Tail rotor.	Individually, without course notes Duration : 2 hours			9 <sup>th</sup> week	<u>Theory :</u> 20%
Helicopter flight component aerodynamic principal.	A 20 minutes oral presentation. Teams of 2 (individually evaluated) Each students will be attributed a subject.	Establish links between aerodynamic principles and different helicopter components.	<b>2</b>	9 <sup>th</sup> week	<u>Laboratory :</u> 10%
Written exam no. 3 Main rotors aerodynamic principle, main rotors static and dynamic balancing, helicopter pre flight and landing.	Individually, without course notes Duration : 2 hours	Learning objectives: 2.2; 2.3; 3.2; 3.3; 3.4; 1.1 Learning objectives: 2.1;2.3; 3.1	<b>1</b>	15 <sup>th</sup> week	<u>Theory :</u> 20% <u>Laboratory :</u> 20% <b>Total :</b> <b>40%</b>

**1** Right characterization of the physical and aerodynamic phenomena, accuracy of the links established taking into account the problematic, precise localization of components

**2** Answers accuracy given to other students questions, right distinction of the influential factors, clear explanation of the physical phenomena or principles of aerodynamics, correctness of the localization of the component.

**Sub-total theory:           60%**  
**Sub-total laboratory:       40%**  
**TOTAL :                       100%**

## **REQUIRED MATERIAL**

The only authorized calculator model for exam periods is SHARP EL 531.

## **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

## **OU**

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*, available at the library.



## **REQUIREMENTS TO PASS THE COURSE**

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

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

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

Attendance at summative evaluation activities is mandatory. (PIEA, article 5.2.5.1).

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

Homework required by the teacher must be handed in at the established date, place and time. The penalties associated with delays are established according to departmental rules (PIEA, article 5.2.5.2).

In case of delay the penalties are:

- See section « Règles des départements » at the following website link:  
<http://guideena-en.cegepmontpetit.ca/department-rules/>

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

The student must meet the "Written Work Standard Presentation" adopted by the CEGEP. Non-compliance with these standards may delay the acceptance of 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](http://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/>

## **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.

## **OTHER DEPARTMENTAL REGULATIONS**

Students are encouraged to consult the website for the specific regulations for this course:

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

## **INSTITUTIONAL POLICIES AND REGULATIONS**

All students enrolled in the École nationale d'aérotechnique of Édouard-Montpetit CEGEP must be aware of and comply with the contents of institutional policies and regulations. In particular, the *Politique institutionnelle de la langue française (PILF)*, the *Politique pour un milieu d'études et de travail exempt de harcèlement et de violence (PPMÉTEHV)*, the *conditions of admission and academic progress*, the *procedure dealing with student complaints within educational relations*.

The complete version of these policies and regulations is available on the CEGEP website at the following address: <http://www.cegepmontpetit.ca/ena/a-propos-de-l-ecole/reglements-et-politiques>. In case of discrepancy between the version appearing elsewhere and the complete version, the complete version will be applied and will be considered the official version for legal purposes.