

COURSE OUTLINE

COURSE: **Propeller Maintenance**

PROGRAM: 280.C0 Aircraft Maintenance

DISCIPLINE: 280 Aeronautics

WEIGHTING: Theory: 1 Practical: 2 Personal Study : 1

Instructor(s)	Office	☎ Extension	✉ email or website
David Richer	D-113C	4614	david.richer@cegepmontpetit.ca

OFFICE HOURS

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Morning					
Afternoon					

Coordinator(s)	Office	☎ Extension	✉ email or website
Robert Champagne	D-113C	4696	robert.champagne@cegepmontpetit.ca

CONTEXT OF THIS COURSE IN THE PROGRAM

This course is offered during the fifth semester of the program. By the end of the course, students will have developed the ability to:

- Gather the necessary information for propeller maintenance
- Perform the removal and disassembly of propellers and their systems
- Perform an inspection and repair propellers and their systems
- Perform the assembly and installation of propellers and their systems
- Perform a compliance inspection for propeller installation

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 ».

COMPETENCIES OF THE EXIT PROFILE (STUDENT SKILL PROFILES)

Perform maintenance on propellers.

MINISTERIAL OBJECTIVE(S) AND COMPETENCIES

0264 To maintain propellers and propeller-related systems.

TERMINAL OBJECTIVE OF THE COURSE (FINAL COURSE OBJECTIVE)

To verify conformity of propeller systems and propeller installation.

TEACHING AND LEARNING STRATEGIES

Theory:

Students will enrich their course notes with the multi-media presentations that will be followed by formal lectures

Practical Work:

This part consists mainly of laboratory work where students must refer to manufacturer's manuals by following procedures and theoretical notes while using the equipment and precision tools.

COURSE PLAN – THEORY

Activity Periods: Weeks 1, 2, 3

Learning Objectives	Content	Personal Study Activities
1.1 Explain the factors that influence the performance and design of a propeller	<ul style="list-style-type: none"> ▪ Definition of blade profiles, lift, angle of attack, blade angle, plane of rotation, relative wind ▪ Effects of various forces at play on the design (pitch, twist and shape of the blades) ▪ Materials used for construction; advantages and disadvantages ▪ Effects on the airplane, dissymmetry of thrust, critical power, gyroscopic effect 	Theory class documents and related activities.
1.2 Explain the principles of operation of various types of propellers and propeller systems.	<ul style="list-style-type: none"> ▪ Definition and use of propellers and systems : fixed pitch, variable pitch or constant speed ▪ Examples of application of the different types 	Theory class documents and related activities.
1.3 Explain the different modes of operation of a propeller or a propeller system.	<ul style="list-style-type: none"> ▪ Definition of : feathering, reverse thrust, propulsion ▪ Examples of applications of the different modes 	Theory class documents and related activities.
1.4 Describe the devices used at the base of propeller systems.	<ul style="list-style-type: none"> ▪ Springs and basic forces on the blade angle ▪ Usefulness of the other hydraulic, pneumatic or electric devices on the blade angle 	Theory class documents and related activities.
1.5 Explain the control and security systems of propeller systems.	<ul style="list-style-type: none"> ▪ Definition and effects of the regulator, synchronizer and synchrophasor systems 	Theory class documents and related activities.

Activity Periods: Weeks 5, 6, 7

Learning Objectives	Content	Personal Study Activities
1.5 Explain the control and security systems of a propeller	<ul style="list-style-type: none"> ▪ Definition and effects of the regulator, synchronizer and synchrophasor systems 	Theory class documents and related activities.
1.6 Describe measuring and control devices for the performance of a propeller and a propeller system	<ul style="list-style-type: none"> ▪ Definitions of speedometer, torque and angle of incidence ▪ Examples of instrument use 	Theory class documents and related activities.
1.8 Identify the propellers and the propeller systems according to the manufacturer's specifications	<ul style="list-style-type: none"> ▪ Finding the serial and model number of the propeller or the system 	Theory class documents and related activities.

COURSE PLAN – PRACTICAL WORK

Activity Periods: Weeks 1 to 15

Learning Objectives	Content	Personal Study Activities
1.7 Identify the safety requirements for work on propellers and propeller systems	<ul style="list-style-type: none"> ▪ Determining whether the propeller must be removed or not according to the work plan ▪ If the propeller is not removed, putting it in a safe position (angle of incidence); make sure that the engine cannot start (remove magnetos and spark plugs); wear safety glasses ▪ If the propeller is removed, making sure that the engine cannot start ; wear safety glasses, secure the propeller on the work bench 	Laboratory notebook: see exercises related to laboratories
1.9 Identify relevant information in the documentation of regulations for the maintenance of propellers and propeller systems.	<ul style="list-style-type: none"> ▪ Special documents (measurement recording and inspection sheets, and work documents) ▪ Laws and regulations specific to the maintenance of propellers and propeller systems ▪ Logbooks and entries to make during maintenance 	Laboratory notebook: see exercises related to laboratories

Learning Objectives	Content	Personal Study Activities
2.1 Use relevant documentation for the maintenance of propellers or propeller systems.	<ul style="list-style-type: none"> ▪ Identifying the propeller or the system according to the model or the serial number ▪ Finding allowable limits when conducting an inspection ▪ Validating the application of the propeller or propeller system using logbooks. 	Laboratory notebook: see exercises related to laboratories
2.2 Apply the laws and regulations relevant to maintenance of propellers or propeller systems.	<ul style="list-style-type: none"> ▪ Researching laws and regulations that apply to particular cases ▪ Tracking using logbooks 	Laboratory notebook: see exercises related to laboratories
2.3 Plan the logical sequence of operations for maintenance of propellers or propeller systems	<ul style="list-style-type: none"> ▪ Using the documentation that accompanies propellers, deciding the sequence of operations according to those possible: removal, disassembly, balancing, cleaning, repairing, assembling, installing, adjusting linkages 	Laboratory notebook: see exercises related to laboratories
2.4 Plan and identify the use of material necessary for maintenance of propellers or propeller systems.	<ul style="list-style-type: none"> ▪ Using the documents and the logical sequence of operations, finding equipment, material and hardware necessary and arranging them in a safe manner 	Laboratory notebook: see exercises related to laboratories

Learning Objectives	Content	Personal Study Activities
3.1 Apply safety rules for removing propellers or propeller systems.	<p>Steps to follow:</p> <ul style="list-style-type: none"> ▪ Using protective equipment (goggles, gloves, etc.) ▪ Establishing a safety zone ▪ Ensuring that the propeller is correctly positioned for removal according to the manufacturer's manual ▪ Ensuring that the engine will not start 	Laboratory notebook: see exercises related to laboratories
3.2 Use the procedure described in the manufacturer's manuals for removing propellers or propeller systems.	<ul style="list-style-type: none"> ▪ Visual inspection of propellers, propeller systems and/or linkages ▪ Identification of useful reference points (position marks) Removal as per the procedure ▪ Visual inspection of the removed pieces 	Laboratory notebook: see exercises related to laboratories
3.3 Analyze inspection results and the guidelines on relevant documents.	<ul style="list-style-type: none"> ▪ Learning to write inspection results in special documents or in the logbooks according to the limitations described in the manuals or the documents that accompany the propeller or propeller system 	Laboratory notebook: see exercises related to laboratories

Learning Objectives	Content	Personal Study Activities
4.1 Apply safety rules for dismantling propellers or propeller systems.	<p>Steps to follow:</p> <ul style="list-style-type: none"> ▪ Using protective equipment (goggles, gloves, etc.) ▪ Establishing a safety zone ▪ Installing parts on an appropriate table 	Laboratory notebook: see exercises related to laboratories
4.2 Use the procedure written in the manufacturer's manual for the disassembly	<p>Steps to follow:</p> <ul style="list-style-type: none"> ▪ Using the specialized equipment and tools that are recommended in the manual ▪ Making sure to record the position marks ▪ Removal, inspecting and handling of equipment according to procedures ▪ Cleaning, identifying and storing parts according to procedures ▪ Recording work done in appropriate documents 	Laboratory notebook: see exercises related to laboratories

Learning Objectives	Content	Personal Study Activities
5.1 Apply safety rules for inspecting propellers and propeller systems	Steps to follow : <ul style="list-style-type: none"> ▪ Using protective equipment (goggles) ▪ Establishing a safety zone ▪ Installing parts on an appropriate support (inspection table) 	Laboratory notebook: see exercises related to laboratories
5.2 Follow the inspection rules in the manufacturer's manual	<ul style="list-style-type: none"> ▪ Choosing appropriate tools and gauges based on the inspections to be performed: measuring the angle of incidence, the blade angle, the thickness, the depth, the diameter and performing a visual inspection ▪ Carrying out the inspection 	Laboratory notebook: see exercises related to laboratories
5.3 Analyse the inspection results and the guidelines in relevant documents.	<ul style="list-style-type: none"> ▪ Comparing the results with the standards in specialized documents and/or logbooks ▪ Making a diagnosis that describes the defect ▪ Recording inspection maintenance results in appropriate tracking document 	Laboratory notebook: see exercises related to laboratories

Learning Objectives	Content	Personal Study Activities
6.1 Apply safety rules for repairing propellers and propeller systems	Steps to follow: <ul style="list-style-type: none"> ▪ Using protective equipment (goggles, gloves, etc.) ▪ Establishing a safety zone ▪ Installing parts on an appropriate support 	Laboratory notebook: see exercises related to laboratories
6.2 Analyze defects in the propeller or propeller system	<ul style="list-style-type: none"> ▪ identifying and describing the defect found on the part during the visual inspection by using the diagnosis written in the documentation 	Laboratory notebook: see exercises related to laboratories
6.3 Suggest a solution for the defect that was found	<ul style="list-style-type: none"> ▪ Solutions: adjusting linkages; repairing surface defects; balancing, adjusting alignment, or indicating not reparable 	Laboratory notebook: see exercises related to laboratories
6.4 Make the repair and record the results in the relevant documents	<ul style="list-style-type: none"> ▪ Choosing the necessary specialized equipment or tools ▪ Using the manufacturer's manual to perform the repair ▪ Visual inspection or using instruments to check the results of the repair ▪ Recording results in writing in the documentation 	Laboratory notebook: see exercises related to laboratories
6.5 Analyze the results of the repair and record them in the relevant documents	Determining the success of the repair Recording the decision in writing in the documents and logbooks	Laboratory notebook: see exercises related to laboratories

Learning Objectives	Content	Personal Study Activities
7.1 Apply safety rules for installing propellers and propeller systems	Steps to follow: <ul style="list-style-type: none"> ▪ Using protective equipment (goggles, gloves, etc.) ▪ Establishing a safety zone ▪ Installing parts on an appropriate support 	Laboratory notebook: see exercises related to laboratories
7.2 Use the procedure described in the manufacturer's manual for installing propellers or propeller systems	<ul style="list-style-type: none"> ▪ Using the specialized equipment and tools recommended in the manual ▪ Using position marks already recorded, torques ▪ Checking results and balance if necessary 	Laboratory notebook: see exercises related to laboratories
7.3 Record the results of the installation in the appropriate documents	<ul style="list-style-type: none"> ▪ Specialized documents and logbooks must contain information on installation 	Laboratory notebook: see exercises related to laboratories

Learning Objectives	Content	Personal Study Activities
8.1 Apply safety rules for installing propeller and propeller systems	Steps to follow: <ul style="list-style-type: none"> ▪ Using protective equipment (goggles, gloves, etc.) ▪ Establishing a safety zone ▪ Ensuring that the propeller is correctly positioned for installation according to the manufacturer's manual ▪ Making sure that the engine cannot start 	Laboratory notebook: see exercises related to laboratories
8.2 Use the procedure described in the manufacturer's manual for installing propellers or propeller systems	<ul style="list-style-type: none"> ▪ Using appropriate specialized equipment and tools ▪ Using reference points already recorded ▪ Carefully following the procedure according to the type of shaft splined or tapered ▪ Adjusting parts (linkages, regulators, etc.) ▪ Visual inspection of the propeller, the linkages, the controls and the regulators 	Laboratory notebook: see exercises related to laboratories
8.3 Analyze the inspection results and the guidelines in the relevant documents	<ul style="list-style-type: none"> ▪ Determining the success of the installation after inspecting and writing the results in the specialized documents and/or logbooks 	Laboratory notebook: see exercises related to laboratories

Course Outline 280-5A3-EM: Propeller Maintenance

Learning Objectives	Content	Personal Study Activities
9.1 Apply safety rules for checking compliance on the installation of propeller and propeller systems	<p>Steps to follow:</p> <ul style="list-style-type: none"> ▪ Using protective equipment (glasses, gloves, etc.) ▪ Establishing a safety zone ▪ Installing the propeller or the system safely on a test apparatus according to established procedures 	Laboratory notebook: see exercises related to laboratories
9.2 Use the procedure described in the manufacturer's manual for checking compliance of the installation of propellers and propeller systems	<ul style="list-style-type: none"> ▪ Researching the procedure in the documents and using the necessary tools ▪ Running the system on the mockup test bench or aircraft engine ▪ Checking and recording results in the appropriate documents 	Laboratory notebook: see exercises related to laboratories
9.3 Analyze the results of the inspection and the guidelines in the relevant documents	<ul style="list-style-type: none"> ▪ Determining if the check was successful or not according to the standards ▪ If successful, recording it in the specialized documents and the logbooks. ▪ If not successful, returning it for inspection 	Laboratory notebook: see exercises related to laboratories

Learning Objectives	Content	Personal Study Activities
10.1 Apply rules related to health and safety in the workplace	<ul style="list-style-type: none"> ▪ Using necessary protective equipment (glasses, gloves, dust masks, etc.) ▪ Storing tools and equipment a 	Laboratory notebook: see exercises related to laboratories
10.2 Apply environmental rules for the workplace	<ul style="list-style-type: none"> ▪ Disposal of fluids in an appropriate place ▪ Storing cleaning cloths in the provided bin ▪ Making certain the workplace is clean 	Laboratory notebook: see exercises related to laboratories

Course Outline 280-5A3-EM: Propeller Maintenance

	Theory 2hr/week (15hr/session)		Laboratory 2 hr/week (30 hr/session)
1-2	Course Outline Introduction to Propeller Historical facts.	1	Course Outline Familiarization with Propellers Lab class equipment presentation Removal/Installation F/P propeller Visual inspection Propeller Tracking Propeller safety (Locking wire practice)
3-4	Propeller vocabulary Operational constraints	2	Propeller conformity (Propeller work sheet) Removal/Installation F/P propeller Visual inspection Propeller Tracking Propeller safety (Locking wire practice)
4-5	Side effects of propellers Wooden propeller construction	3	Perform a conformity check on F/P propeller.
6-7	EVALUATION (25%)	4	Perform propeller static balancing
8-9	Aluminium propeller construction Composite propeller	5	Familiarization with McCauley D2A Propeller C/P conformity explanation Propeller research explanation
10-11	Constant speed propeller (C/S) Propeller Governor	6	Perform a conformity check on a C/S propeller
12-13	Propeller systems	7	Explanation of a blade section minor repair Hartzell Compact speed propeller presentation Propeller governor gaskets
14-15	FINAL EVALUATION (25%)		
		8	Perform a Blade section repair
		9	EVALUATIONS : Half-session lab exam (15%) Blade repair inspection (10%)
		10	Exam correction HCB3 propeller explanation (virtual test banch)
		11-12- 13-14	Removal , installation Hartzel compact C/S
			Hartzell Hub dismantling
			Removal installation Hamilton Hydromatic propeller Propeller Deicing system troubleshooting
15	FINAL EVALUATION (15%) Propeller research (10%)		

The periods indicated for activities on the Propulsion Department course outlines are approximate. Modifications may be made due to logistical problems or situations.

Weeks	Learning Objectives
1	2.1- 2.2- 2.3- 1.7- 1.9
2	2.1- 2.2- 2.3
3	2.1-2.2-10.1-2.3-2.4-5.2-5.3-3.3-10.2
4	2.1-2.2-1.7-1.9
5	2.1-2.2-10.1-2.3-2.4-5.2-5.3-3.3-10.2
6	4.1-4.2
7	6.1-6.2-6.3-6.4-6.5-10.1-10.2
8	Blade repair exercise 6.1- 6.2- 6.3- 6.4- 6.5- 10.1- 10.2
9	EXAM
10	9.1-9.2-9.3
11	Rotating activities 4.1- 4.2- 7.1- 7.2- 7.3- 8.1- 8.2- 8.3- 9.1-9.2-9.3- 10.1-10.2
12	
13	
14	
15	EXAM

SYNTHESIS OF EVALUATION METHODS

Theory

Description of the evaluation activity	Context	Learning Objective(s)	Evaluation Criteria	Due Date (date assignment is due or exam date)	Weighting (%)
Written exam: multiple choice answers and short answers	Individual. 2-hour duration without documentation	1.1 to 1.5	Precision and compliance of propeller terminology.	Week 4	25%
Written exam: multiple choice answers	Individual 2-hour duration without documentation	All	Compliance of propeller terminology. Compliance of propeller and propeller systems fonction. Propeller system analysis.	Week 8	25%

Sous-total : 50%

Practical Work

Description of the evaluation activity	Context	Learning Objective(s)	Evaluation Criteria	Due Date (date assignment is due or exam date)	Weighting (%)
Blade repair inspection	Individual In the laboratory	6.1 to 6.5	Depth, propeller blades blending finish, Blade repair specifications, Blade profile.	Week 9	10%
Documentation research work using assigned questions (cases)	In teams, during the course	1.9	Presentation of elements asked in class, completeness of the information	Week 15	10%
Written exam: short answer responses	Individual, 2-hour duration	Objectives for Weeks 1 to 8 (see chart)	Compliance of blade terminology, propeller function comprehension, accuracy of information, completeness of the information.	Week 9	15%

Course Outline 280-5A3-EM: Propeller Maintenance

Comprehensive Exam (Synthesis)	Individual, 2-hour duration Access to documentation permitted	All	Compliance of blade terminology, propeller function comprehension, accuracy of information, completeness of the information.	Week 15	15%
--------------------------------	--	-----	--	---------	-----

Subtotal : 50%

TOTAL: 100%

REQUIRED MATERIAL

Laboratory manual and a SHARP EL 531 calculator.

AIRCRAFT PROPELLERS AND CONTROLS.

MEDIAGRAPHY

F. Delp, *Aircraft Propellers and Controls*, Basin, WY, Aviation Maintenance Publish, 1979, 156 pages.

Direction générale de l'aviation civile, *Mécaniciens : cellule et moteur : manuel moteur*, 1971.

F. Delp, *Aircraft Governors*, I.A.P. Inc., 1979, 50 pages.

Bent, R.D. et McKinley J.L., *Aircraft Powerplants*, 5e éd., McGraw-Hill, Montréal, 1985, 596 pages.

Pratt and Whitney, *PT6-A Descriptive Notes*.

Pratt and Whitney, *PW-100 Descriptive Notes*.

General Aviation Efficiency System. Light Aircraft Microfiche Library System. Propellers, V.6.

Federal Aviation Administration, *AC43-13-1A/2A: Acceptable Methods, Techniques and Practices : Aircraft Inspection, Repair & Alterations*.

REQUIREMENTS TO PASS THE COURSE

1. Passing Mark

The passing mark for this course is 60% by adding the marks for the theory and practical work for the course.

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

Students must be present for summative evaluations and must comply with the instructions given by the instructor to carry out the evaluation activity and written in the course outline. Unexcused tardiness for a summative evaluation could result in being excluded from the activity. Any absence from a summative evaluation that is not due to serious reasons (illness, death in the family, etc.) could result in a mark of zero (0) for the activity.

Students are responsible for meeting with the instructor before an evaluation activity is held or immediately upon returning to ENA to explain the reason for an absence. Proper documentation, such as a medical certificate, a death certificate, legal papers, etc., must be shown if the reason for absence is serious and recognized as such by the instructor(s), arrangements will be made between the instructor(s) and the student to make up the activity.

4. Submitting Assignments

All assignments must be submitted by the date, hour and location designated by the instructor(s). Late assignments will be penalized 10% per day that they are late and will receive a mark of zero (0) after one week.

5. Presentation of Written Work

The instructor(s) will provide students with information and guidelines regarding the presentation of written work. When the presentation of an assignment is unacceptable, the work will be penalized as a late assignment until an acceptable version is submitted. In this case, the penalties for late work will be applied.

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 www.cegepmontpetit.ca/normes under the heading **Liens éclair, Bibliothèques, « Méthodologie »**.

METHODS OF COURSE PARTICIPATION

Everyone is required to wear workclothes (ENA), safety glasses and safety shoes in the laboratory. Smoking in the lab is prohibited (could cause an explosion) as well as eating and drinking (risk of contamination).

OTHER DEPARTMENTAL REGULATIONS

Students are encouraged to consult the website 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, 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.

NOTE: This Course Outline is a translation of the *Plan de cours* for 280-443-EM: *Fonctionnement et maintenance des hélices*. If there is a discrepancy, then the original French version will be considered the official version for legal purposes.

APPENDIX

The activity periods in the course outline are approximate. Changes may be made to adapt to any logistical problems that might arise during the session.