ÉCOLE NATIONALE D'AÉROTECHNIQUE

UNE ÉCOLE AFFILIÉE AU CÉGEP ÉDOUARD-MONTPETIT

280-3B4-EM

Fall 2023

Pre-Flight Department

Course outline

COURSE :	**Aerodynamics**	
PROGRAM :	280.C0	Aircraft Maintenance
DISCIPLINE :	280	Aeronautics
WEIGHTING :	*Theory : 2*	*Practice : 2*	*Personal Study : 2*

Teacher(s)	**Office**	**☎ extension**	**✉ e-mail ou website**
Jetté, Éric	C-182	4615	eric.jette@ena.ca

Office hours

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Morning		10:00 -12:00		8:00 - 10:00	
Afternoon		12:00 – 14:00			
Other					

Coordinator(s)	**Office**	**☎ extension**	**✉ e-mail**
Mora, Joaquin	C-160	4220	joaquin.mora@ena.ca
Rancourt, Serge	C-160	4664	serge.rancourt@ena.ca

1 CONTEXT OF THIS COURSE WITHIN THE PROGRAM

This course is offered during the third session of the program and is designed for all students in the Aircraft Maintenance Technology program. By the end of this course, students will have developed:

- The ability to recognize factors that influence drag and lift on aircraft.
- The ability to recognize factors that influence the propulsive force of propellers.
- The ability to make calculations in order to compare and observe aircraft performance.
- The ability to recognize factors that influence aircraft performance.

- 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) according to Transport Canada requirements. The application of Transport Canada policies regarding absences is available on the *Ma réussite à l'ÉNA* website under the heading « Privilèges accordés par Transports Canada ».

2 COMPETENCIES OF THE EXIT PROFILE (STUDENT SKILL PROFILES)

Master the scientific bases and those of the work functions.

3 MINISTERIAL OBJECTIVE(S) AND COMPETENCIES

0260 To apply the principles of aerodynamics

4 TERMINAL OBJECTIVE OF THE COURSE (FINAL COURSE OBJECTIVE)

Recognize, gauge and quantify the factors that influence the design performance and aerodynamic parameters of an aircraft, subject to conditions of use and maintenance activities.

5 TEACHING AND LEARNING STRATEGIES

The technical methodologies will be in class teaching supported by written and multimedia material distributed by Microsoft Teams where students chatting is also highly encouraged. Theory classes will last 2 hours per week. Labs will be 2 hours per week at the school.

Theory:

- The theory part of the course is divided into four modules that deal with advanced concepts of the principles of aerodynamics, aircraft performance and flight.
- Formal lectures will be supported with examples, exercises, illustrations, transparencies, multimedia projection, video, photographs and aircraft parts as teaching aids.
- Before summative evaluations, students will be informed of the important points and elements of the study table which could be targeted on the exam to allow them the best opportunity to succeed in the course.
- Students will complete their learning with their class notes, reviewing exercises and homework.
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Laboratory:

- The laboratory part of the course is divided into five modules that deal with advanced concepts of aerodynamics. Students will apply and validate the theoretical elements through wind tunnel tests.
- Students will complete their learning with class notes, reviewing exercises and homework.
- Transparencies, multimedia projection, videos, photographs and aircraft parts will be used as teaching aids.

Warning: exercises or preparatory activities in class (theory) and in the laboratory (practical work) assigned by the instructor(s) must be completed before arriving in class or the laboratory. The instructor(s) reserve the right to refuse access to class or the lab if the exercises have not been completed beforehand and the absence will be recorded in the student's file. It is the student's responsibility to finish exercises in time.

In case of an absence, it is the student's responsibility to find out from classmates what was done in class and the work that was assigned in order to be up to date (refer to the learning objectives in the *Synthesis of Summative Evaluation Methods table*)

6 COURSE PLAN

LEARNING OBJECTIVES

1. Recognize the major inherent laws, constants and variables of aerodynamics.
2. Recognize different facets of air resistance and different types of drag.
3. Analyser les facteurs qui influencent le coefficient de portance (C_z) et la portance.
4. Recognize the factors that influence aircraft performance.
5. Explain the theory of propulsion for a propeller.

Theory

WEEK	# OBJECTIVE	CONTENT	MODE OF INSTRUCTION AND LEARNING ACTIVITIES	DOCUMENTATIONS, RESOURCES, TECHNOLOGICAL TOOLS AND URL ADDRESS
1		Presentation		
2	1	Mass & Weight	In class, Complete workbook	Workbook 1 from MS Teams
3	1	Length distance & time		Workbook 2 in Teams
4	1	Surface calculations & earth atmosphere		Workbook 3 in Teams
5	2, 3, 4	The choice of altitude		Workbook 4 in Teams
6	1 to 4	Exam 1 Workbook 1 to 4		Pen & Calculator
7	4	Fuel flow rate	In class, Complete workbook	Workbook 5 in Teams
8	2, 3, 4	The speed of an aircraft		Workbook 6 in Teams
9	2, 3, 4	The envelopes: speed and load factor		Workbook 7 in Teams
10	2, 3, 4	Load factor, radius & turn rate		Workbook 8 in Teams
11	1 to 4	Exam 2 Workbook 5 to 8		Pen & Calculator
12	2, 3, 4	Wing load & drag	In class, Complete workbook	Workbook 9 in Teams
13	2, 3, 4	Aerodynamics And the air aircraft maintenance Engineer Propellers		Workbook 10 in Teams
14	5	Propellers & Revision questions		Workbook 1 to 11 in Teams
15	1 to 5	Examen 3 Workbook 1 to 11		Workbook 1 to 11 Pen & Calculator

Lab.

WEEK	# OBJECTIVE	CONTENT	MODE OF INSTRUCTION AND LEARNING ACTIVITIES	DOCUMENTATIONS, RESOURCES, TECHNOLOGICAL TOOLS AND URL ADDRESS
1		Presentation		
2	1	Fundamentals	In the lab., Perform the experiment as per the written instructions from the lab. document and analyse the results	Lab. 1 from MS Teams
3	1	Calibration of the Göttingen wind tunnel		Lab. 2 from MS Teams
4	2, 4	Pressure distribution around a disk		Lab. 3 from MS Teams
5	3, 4	Distributions of pressures around a wing profile		Lab 4 from MS Teams
6	3, 4	Pressure distribution around the airfoil		Lab. 5 from MS Teams
7	1 to 4	Exam 1		Personnal Sheet 1.5 x 11 DS Pen & Calculator
8	2, 4	Drag of a missile vs. nose shape	In the lab., Perform the experiment as per the written instructions from the lab. document and analyse the results	Lab 7 from MS Teams
9	2, 4	Rate of drag reduction by adding a fairing		Lab 8 from MS Teams
10	2, 3. 4	The effect of the aspect ratio and winglets on a wing and the Reynolds number		Lab. 9 from MS Teams
11	1 to 4	Difficulty of scaling & equivalence of Reynolds number		Lab. 10 from MS Teams
12	1 to 4	Exam 2		Personnal Sheet 1.5 x 11 DS Pen & Calculator
13		Characteristic of a wing	In the lab., Perform the experiment as per the written instructions from the lab. document and analyse the results	Lab. 12 from MS Teams
14		Propellers		Lab. 13 from MS Teams
15		Examen 3		Personal Sheet 1.5 x 11 DS Pen & Calculator

7 SYNTHESIS OF SUMMATIVE EVALUATION METHODS

Description of Evaluation Activity	Context	Learning objective(s)	Evaluation Criteria[1]	Due Date (approximate date assignment due or exam given)	Weighting (%)
Th. Exam on basic variables and parameters affecting drag and lift	In class, individual, without any notes, Short development and multiple-choice answers. Questions, comparisons and calculations based on the descriptive sheets of airplanes, calculations on the properties of fluids facing variables. Questions referring to homework and courses.		See table 1	September 27th	15
LB. Exam on: - wind tunnel calibration, - pressure zones, - form and profile drag	In class, individual, Personnal Sheet 1.5 x 11 DS. The exam includes manipulations, calculations and written reports. Short development and multiple-choice answers. Questions, comparisons and calculations based on data tables obtained from laboratories, calculations on the properties of fluids versus variables. Questions referring to laboratories of weeks 1 to 4.		See table 2	October 3rd	10
Th. Exam on drag and lift	In class, individual, without any notes, Short development and multiple-choice answers. Questions, comparisons and calculations based on the descriptive sheets of airplanes, calculations on the properties of fluids facing variables. Questions referring to homework and courses.		See table 1	November 15th	20
Lb. Exam on: - Lift and Cz of the wing, - Drag and Cx of the wing, - the effect of: - aspect ratio, - the Reynolds number	In class, individual, Personnal Sheet 1.5 x 11 DS. The exam includes manipulations, calculations and written reports. Short development and multiple-choice answers. Questions, comparisons and calculations based on data tables obtained from laboratories, calculations on the properties of fluids versus variables. Questions referring to laboratories of weeks 6 to 9..		See table 2	November 21st	15
Lb. Exam on: - moments - wing plan shapes, - drag and lift of the entire aircraft, - chart drag / speed - propellers	In class, individual, Personnal Sheet 1.5 x 11 DS. The exam includes manipulations, calculations and written reports. Short development and multiple-choice answers. Questions, comparisons and calculations based on data tables obtained from laboratories, calculations on the properties of fluids versus variables. Questions referring to laboratories of weeks 1 to 14.		See table 2	December 20th	15
Th. Terminal evaluation.	In class, individual, open book, Short development and multiple-choice answers. Questions, comparisons and calculations based on the descriptive sheets of airplanes, calculations on the properties of fluids facing variables. Questions referring to homework and courses.		See table 1	Dececember 19th	25
				TOTAL	**100 %**

[1] Issus du programme d'études (critères de performance) et adaptés au niveau des étudiants (exigences évolutives) d'une session à l'autre. Les critères d'évaluation doivent être explicites et permettre l'observation des résultats (processus, produits, propos).
Les critères d'évaluation seront présentés par écrit aux étudiants au moins une semaine avant l'activité d'évaluation sommative (article 5.1j PIEA)

Presentation **Table 1 Evaluation criteria**

A) Correct interpretations of performance factors.
B) Correct enumeration of Performance Factors.
C) Correct distinction of the factors involved in the flight and performance elements. (T and 172 vs 172)
D) Accuracy of justification when quantifying performance factors. (=)
E) Correct comparison between factors and variables.
F) Appropriate selection of units of measurement.
G) Accuracy of calculations.
H) Accuracy of comparisons.
I) Appropriate mapping of principles and phenomena.
J) Accuracy of established links considering the issue.
K) Evaluation and truthful analysis of the quantitative value of the response.
L) Validity of the approach in the resolution of numerical, technical or situational problems.
M) Precise use of terminology.

Table 2 Evaluation criteria

A) Accuracy in the manipulations.
B) Accuracy during the acquisition of data.
C) Accurate interpretation of the data.
D) Correct choice of units of measurement.
E) Accuracy of calculations.
F) Appropriate mapping of principles, phenomena and results.
G) Accuracy in the use and interpretation of graphs.
H) Evaluation and truthful analysis of the quantitative value of the answer.
I) Accuracy of justification when quantifying performance factors. (=) Vs AR
J) Correct Enumeration of Performance Factors.
K) Accuracy of comparisons.
L) Accuracy of the links established mapping considering the problem.
M) Validity of the approach in the resolution of numerical, technical or situational problems.
N) Precise use of terminology.

8 REQUIRED MATERIAL

- Documents for class and Labs available in Teams.
- SHARP EL 531 Calculator
- Safety glasses and shoes are compulsory at all times in the laboratories.
- In addition, ÉNA students must wear ÉNA-branded clothing when they visit the laboratories and hangars. The authorized pants are work pants or jeans in good condition (no decoration: studs, metal parts, etc.)
- Wearing a sweater with a hood with a cord is not authorized, because there is an OHS risk with the equipment or machine.

9 MEDIAGRAPHY

1. Chuan-tau E. et Roskam, J. Dr. (1990). *Airplane Aérodynamics*, Roskam. Aviation and Engineering Corporation, Lawrence, Kansas : University of Kansas
2. Hurt, H. H. (1965). *Aerodynamics for naval aviators*. University of Southern California, USA
3. Kermore, A.C. Translation by Didier Feminier. (2000). *Mécanique du vol.*, Outremont, Canada : Modulo
4. Cauvin, D. (1979). *Aérodynamique mécanique du vol*. Paris, France : Institut aéronautique Jean Mermoz
5. Giles, R.V. (1984). *Low-Speed Wind Tunnel Testing*, USA, John Wiley & Sons, Mcgraw-Hill, 1984
6. Giles, R.V. (1975). *Mécanique des fluides et hydrauliques*, cours et problèmes, Série Schaum, Toronto, Canada : Mcgraw-Hill
7. Rice, *Handbook of airfoil sections for light aircraft*
8. https://www.youtube.com/channel/UC-795KiMElgoKZ7SAx77Mjw/featured

10 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. 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.

3. 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.

4. 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 inacceptable, 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 at : http://rmsh.cegepmontpetit.ca/normes-de-presentation-materielle-des-travaux-ecrits-du-cegep/

5. Plagiarism and other breaches of academic integrity

a) Plagiarism consists of copying, translating, paraphrasing, in whole or in part, the work of another person and wrongfully attributing it to oneself, with or without their consent, and constitutes a breach of academic integrity.

b) The use of works generated entirely or partially by artificial intelligence, if not authorized by the professor, is also considered a breach of academic integrity.

c) Acts of fraud, such as impersonating another student during a summative assessment, deceiving, cheating, or falsifying documents or results, also constitute breaches of academic integrity.

d) Any collaboration in such acts or any attempt to commit them is also considered a breach of intellectual ethics.

Any violation of intellectual honesty, as well as any attempt at or collaboration in such an action will result in a mark of "0" for the exam, the assignment or the evaluation activity in question. In this case, the teacher will make a written report to departmental coordination which will be transmitted to the Dean of Studies in accordance with Article 5.6.1 IPESA).

6. METHODS OF COURSE PARTICIPATION

The following rules must be respected in the classroom and laboratories:

In the classroom:

- Food, drinks cell phones, pagers, MP3 players, IPODs, cameras and any similar devices are prohibited.
- Students must keep the classroom clean and tidy.

In the laboratory:

- Food, drinks cell phones, pagers, MP3 players, IPODs, cameras and any similar devices are prohibited.
- Students must keep the classroom clean and tidy.
- Flames (from a lighter, matches) are prohibited.
- ENA overalls (jumpsuit) and safety shoes or boots are **mandatory**. Students who are not properly dressed will not be admitted to the workshop or hanger and the absence will be recorded in their file.
- Safety glasses are **mandatory** for working with wind tunnels and must be at hand in the hangars.
- Students may not use aircraft or equipment without authorization from an instructor and proper operating instructions must be respected.
- It is prohibited to get up on a stool, a table, a workbench or a wind tunnel.
- There must never be more than 3 students per team unless otherwise indicated by the instructor and there must never be more than one team per workbench or aircraft.
- Students must clean the workbench and put equipment away after being used; the premises must be left clean and organized.

7. OTHER DEPARTMENTAL REGULATIONS

Students are encouraged to consult the website for the specific regulations for this course:
http://guideena-en.cegepmontpetit.ca/department-rules/
https://mareussite.cegepmontpetit.ca/ena/mon-parcours/mon-programme/regles-departementales

8. 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.

9. STUDENT ACCESSIBILITY CENTER - FOR STUDENTS WITH DISABILITIES

Students having received a professional diagnosis of impairment (motor skills, neurological, organic, sensory, learning difficulties, mental health, autism spectrum disorder or other) or suffering from a temporary medical condition may request special accommodations.

Students seeking these accommodations must forward their diagnosis to the CSA by either MIO to "Service, CSA-ENA" or email to "servicesadaptesena@cegepmontpetit.ca".

Students already registered with the CSA must communicate with their teachers at the beginning of the semester to discuss those accommodations they have been awarded by the CSA.

10. ANNEX