ÉCOLE NATIONALE D'AÉROTECHNIQUE
UN CAMPUS DU CÉGEP ÉDOUARD-MONTPETIT

280-5A6-EM
FALL 2016
Propulsion department

COURSE OUTLINE

COURSE: **Engine Performance**

PROGRAM: 280.C0 Aircraft Maintenance

DISCIPLINE: 280 Aeronautics

WEIGHTING: Theory: 3 Practical Work: 3 Personal Study: 2

Instructor(s)	Office	☎ Extention	✉ Email or Website
David Richer	D-113C	4614	david.richer@cegepmontpetit.ca

OFFICE HOURS

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Morning					
Afternoon					

Coordinator	Office	☎Ext	✉ Email or Website
Robert Champagne	D-113C	4696	robert.champagne@cegepmontpetit.ca

CONTEXT OF THIS COURSE IN THE PROGRAM

The course *Engine Performance* aims to have students:

- Understand the performance of piston and turbine engines to be able to use them within their optimum range of operation.
- Be able to troubleshoot an engine being repaired for reduced performance and compare it to ideal performance.
- Be able to compare the performance of various aircraft with different types of engines.
- 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 ENA 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 engines

MINISTRY OBJECTIVE(S) AND COMPETENCIES

026B To assess the performance of piston and turbine engines.

TERMINAL OBJECTIVE OF THE COURSE (FINAL COURSE OBJECTIVE)

To assess the performances of piston and turbine engines.

TEACHING AND LEARNING STRATEGIES

Theory:

The method, teaching and learning style use standard pedagogical techniques such as:

- formal lectures
- use of model engines
- films
- parts
- computing software

Practical Work:

The method, teaching and learning style use standard pedagogical techniques such as:

- lab notes
- functioning engines and parts
- Volvo Diesel engine
- Chrysler gas engine
- Rover gas turbine
- SR-30, heat pump

For data reading and for analysis:

- Measuring instruments

Students will perform engine tests in the laboratory.

COURSE PLAN– THEORY

Activity Periods: **Throughout the Session**

Learning Objective	Content	Personal Study Activities
1. Master simple calculations and units with the ideal gas equation and calculating work.	▪ Basic units used in the international system, their inter-relation and simplification ▪ Association of basic units with their physical concept (for work, Joules).	

Activity Period: **Weeks 6 to 15**

Learning Objectives	Content	Personal Study Activities
2.1 Apply the first law of thermodynamics 2.2 Make the link between heat and work 2.3 Calculate the performance of a heat engine. Week 6: Test bench, PT-6	▪ Analysis of engine performance using tools (concepts) from thermodynamics such as the first law, the closed system, open system (control volume), the law of conservation of mass, the second law, steady airflow, etc. ▪ Identification and use for purposes of analysis, the following thermodynamic variables: pressure, temperature, density, internal energy, enthalpy, entropy, etc. ▪ Equation of ideal gases, its limitations, and the related notion of mass heat (constant and variable)	

Activity Periods: **Weeks 11 to 15**

Learning Objective	Content	Personal Study Activities
3.1 Explain the details related to power cycles. 3.2 Compare the performance of various aircraft with different types of engines.	Principles of the following cycles: Carnot, Brayton, turbojet, turboprop, turbo fan, geared fan, and their variations (regenerator, post-combustion)	

COURSE PLAN – PRACTICAL WORK

Activity Periods: **Throughout the Session**

Learning Objectives	Content	Personal Study Activities
1.1 Define the characteristic curves of various engines: diesel, gasoline and turbine. 1.2 Use a variety of measuring instruments.	▪ Using instruments such as the dynamometer, pressure gauge and densimeter, calculate torque, power, fuel flow, air flow, specific fuel consumption and the fuel/air ratio.	
2.1 Demonstrate the various principles of a cooling/heating system. 2.2 Be able to perform certain energy exchange calculations. (Be able to calculate energy exchange.)	▪ Using pressure and temperature measurements, calculate heat exchange and the performance coefficient.	
3. Study the effect of fuel/air mixture in a piston engine.	▪ Calculating the theoretical fuel/air mixture. ▪ Measuring and calculating the effects of a different mixture on the exhaust temperature, torque, power and specific fuel consumption.	
4. Establish energy balances of various piston and turbine engines.	▪ Measuring and calculating the distribution of fuel energy in an engine.	
5. Calculate the performance of various turbine engine components.	▪ Measuring and calculating the power received or produced and the performance of each component, the overall engine thrust.	

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 (%)
Performance Analysis of piston engines and turbines	3 period Individual written exam, with calculator.	1	Precision of calculations. Compliance of units.	Week 5	15%
Performance Analysis of piston engines and turbines	3 period Individual written exam, with calculator.	1 and 2	Precision of calculations. Compliance of units. Accurate analysis of engine performance.	Week 10	15%
Performance Analysis of piston engines and turbines	3 period Individual written exam, with calculator.	all	Precision of calculations. Compliance of units. Accurate analysis of engine performance.	Week 15	20%

Sub-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 (%)
Performance Analysis of piston engines and turbines	3 period Individual written exam, with calculator	1	Precision of calculations. Compliance of units. Accurate analysis of engine performance.	Week 5	10%

Performance Analysis of piston engines and turbines	3 period Individual written exam, with calculator	2, 3 and 4	Precision of calculations. Compliance of units. Accurate analysis of engine performance.	Week 10	10%
Performance Analysis of piston engines and turbines	3 period Individual written exam, with calculator	5	Precision of calculations. Compliance of units. Accurate analysis of engine performance.	Week 15	30%

Sub-total: 50%

TOTAL: 100%

REQUIRED MATERIAL

SHARP EL 531 calculator.

MEDIAGRAPHY

Ahmed F. El-Sayed, Aircraft Propulsion and Gas Turbine Engines, CRC Press, 2008

Saeed Faroki, Aircraft Propulsion, John Wiley & Sons, Inc, 2009

VAN Wylen, Thermodynamique appliquée, éd. Renouveau pédagogique, Montréal, 736 p., 1981.

MATTINGLY, JACK D. elements of gaz turbine propulsion, McGraw-hill, inc 1996

Bensimhon V. Fonctionnement hors adaptation des turbomachines Masson, physique fondamentale et appliquée.

Walsh P.P. et Fletcher P. Gas Turbine Performance The American Society of Mechanical Engineers

Wilson David Gordon et Korakianitis Theodosios The Design of High-Efficieny Turbomachinery and Gas Turbines Prentice Hall

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 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 in the documentation center on the Cégep web site www.cegepmontpetit.ca/normes under the heading ***Liens éclair*, Bibliothèques, « Méthodologie ».**

METHODS OF COURSE PARTICIPATION

Workclothes (ENA)
Safety glasses
Safety shoes

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 280-526-EM: *Analyse de performances aux bancs d'essais*. 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.