Collège
Édouard-Montpetit
École nationale d'aérotechnique

280-5A6-EM
FALL 2011
Propulsion

COURSE OUTLINE

COURSE: **Engine Performance and Thermodynamics**

PROGRAM: 280.03 Aircraft Maintenance

DISCIPLINE: 280 Aeronautics

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

Instructor(s)	**Office**	**☎ Extention**	**✉ Email or Website**
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OFFICE HOURS

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Morning					
Afternoon					

Coordinator(s)	**Office**	**☎Ext**	**✉ Email or Website**
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CONTEXT OF THIS COURSE IN THE PROGRAM

The course *Performance Analysis on Test Benches* 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.

MINISTRY OBJECTIVE(S) AND COMPETENCIES

This program of study is in the process of being revised.

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.	▪ 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)	Due Date (date assignment is due or exam date)	Weighting (%)
Written exam based on calculations	Individual: 3 periods, with calculator and reference tables	1	Week 5	15%
Written exam based on calculations	Individual: 3 periods, with calculator and reference tables	1 and 2	Week 10	15%
Written exam based on calculations	Individual: 3 periods, with calculator and reference tables	all	Week 15	20%

Sub-total : 50%

Practical Work

Description of the Evaluation Activity	Context	Learning Objective(s)	Due Date (date assignment is due or exam date)	Weighting (%)
Laboratory reports (2)	Two (2) individual reports for Weeks 2, 3 and 4	1	Week 5	5%
Written exam	Individual: 3 periods, with calculator and reference tables	1	Week 5	12%
Laboratory reports (4)	Four (4) individual reports for Weeks 6 to 9	2, 3 and 4	Week 10	5%
Written exam	Individual: 3 periods, with calculator and reference tables	2, 3 and 4	Week 10	12%
Laboratory report (1)	Four (4) individual reports for Weeks 11 to 14.	5	Week 15	4%
Written exam	Individual: 3 periods, with calculator and reference tables	5	Week 15	12%

Sub-total: 50%

TOTAL : 100%

REQUIRED MATERIAL

SHARP EL 531 calculator and COOP Course Notes No 4971.

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

INSTITUTIONAL POLICIES AND REGULATIONS

All students enrolled at Collège 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 complete text of these policies and regulations is accessible on the College web site at the following address: www.college-em.qc.ca. If there is a discrepancy 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.

DEPARTMENT REGULATIONS

Students are encouraged to consult the Propulsion Department's website for specific regulations at: www.college-em.qc.ca/ena/propulseur/reglements

APPENDIX

The activity periods in the Course Outline are approximate. Changes may be made to adapt to any logisitical problems that might arise during the session.