

## **Guidance to Instructors on Subject Delivery**

### **JET ENGINE PROPULSION**

#### **Programme of learning:**

- This is a suggested programme for the delivery of this subject.
- The main headings are the Learning Outcomes (LO1, LO2, etc), with sub headings related to topics within those Learning Outcomes (see Glossary of Terms).

#### **Activities:**

- Some practical activities are suggested throughout the programme as a way of reinforcing the learning and adding interest.
- It may be not be practical to undertake all of these activities at the suggested part of the programme.
- Instructors may have to adapt this programme to prevailing circumstances.

#### **Method of delivery:**

- Learning resources can be found on Ultilearn and may be adapted by the instructor, if required.
- Lesson delivery should be as practical as possible and should contain the maximum amount of cadet participation and interaction.

#### **Check of understanding:**

- Each lesson should contain a check of understanding (see Glossary of Terms).
- At the start of each lesson, the previous check of understanding should be reviewed in order to consolidate previous learning before moving on to new learning.

#### **Formative assessment:**

- There should be a formative assessment at the conclusion of each Learning Outcome (see Glossary of Terms).

#### **Summative assessment:**

- This is the Online Assessment, through Ultilearn, of the Assessment Criteria for this subject (see Glossary of Terms).
- Assessment Criteria (see Glossary of Terms) are found on the final page of this document.

<b>JET ENGINE PROPULSION</b>
<b>Introduction:</b> <ul style="list-style-type: none"><li>• Introduction to the subject and assessment method</li></ul>
<b>LO1: Know operating principles of a jet engine cycle and its relevant systems</b>
<b>Introduction:</b> <ul style="list-style-type: none"><li>• Introduce the basic operating principals of a jet engine cycle and its relevant fuel, oil, ignition and cooling systems</li></ul>
<b>Development:</b> <ul style="list-style-type: none"><li>• Introduce the development of the jet engine</li><li>• Explain the historical development of the jet engine, including the work of Sir Frank Whittle</li></ul>
<b>Method of operation:</b> <ul style="list-style-type: none"><li>• Introduce the basic method of operation of a jet engine</li><li>• Explain the principle of the gas turbine engine, including action and reaction</li></ul>
<b>Mechanical arrangement:</b> <ul style="list-style-type: none"><li>• Introduce the mechanical arrangement of a jet engine</li><li>• Explain the layout of a jet engine</li><li>• Explain the main jet engine sections, including:<ul style="list-style-type: none"><li>○ Intake</li><li>○ Compressor</li><li>○ Combustor</li><li>○ Turbine</li><li>○ Exhaust</li></ul></li></ul>
<b>Compressor:</b> <ul style="list-style-type: none"><li>• Introduce the compressor</li><li>• Explain the function of the compressor (draws air, compresses and delivers)</li><li>• Explain the effect of air pressure (improves efficiency)</li><li>• Explain the different types, including:<ul style="list-style-type: none"><li>○ Centrifugal</li><li>○ Axial</li></ul></li><li>• Explain variations in axial compressors (convergent annular duct)</li><li>• Explain the stages, reason and function</li></ul>

**Combustion chamber:**

- Introduce the combustion chamber
- Explain the construction (flame tube or ring of tubes)
- Explain the purpose, including:
  - Most efficient combustion
  - Maximum heat energy
  - Greatest expansion of gases
- Explain the burners and purpose (vaporise fuel)
- Explain the igniters and purpose (initiate combustion)

**Turbine:**

- Introduce the turbine
- Explain the construction, including:
  - Rotating assembly
  - Spool
- Explain the stages, including:
  - Alternate rotating blades
  - Stationary aerofoil section blades
- Explain the function (absorb energy to keep rotating in turbojet)

**Review:**

- Review the basic operating principals of a jet engine cycle and its relevant fuel, oil, ignition and cooling systems

**Formative assessment:**

- Formative assessment of the basic operating principals of a jet engine cycle and its relevant fuel, oil, ignition and cooling systems

<b>JET ENGINE PROPULSION</b>
<b>LO2: Know types of jet engine</b>
<b>Introduction:</b> <ul style="list-style-type: none"><li>• Introduce the different types of jet engine</li></ul>
<b>Main types:</b> <ul style="list-style-type: none"><li>• Introduce the main types of jet engine</li><li>• Explain the design, function, aircraft use and operating principles of the following:<ul style="list-style-type: none"><li>○ Turbojet</li><li>○ Turbofan</li><li>○ Turboprop</li><li>○ Turboshaft</li></ul></li></ul>
<b>Variations:</b> <ul style="list-style-type: none"><li>• Introduce jet engine variations</li><li>• Explain the design, function, aircraft use and operating principles of the following:<ul style="list-style-type: none"><li>○ Vectored thrust</li><li>○ Geared and variable pitch fans</li><li>○ Liftjets</li><li>○ Ramjets</li></ul></li></ul>
<b>Review:</b> <ul style="list-style-type: none"><li>• Review the different types of jet engine</li></ul>
<b>Formative assessment:</b> <ul style="list-style-type: none"><li>• Formative assessment of the different types of jet engine</li></ul>

<b>JET ENGINE PROPULSION</b>
<b>LO3: Understand operating principles of gas turbine engine systems</b>
<b>Introduction:</b> <ul style="list-style-type: none"><li>• Introduce the basic operating principals of gas turbine engine systems such as reheat and thrust reverser systems</li></ul>
<b>Systems:</b> <ul style="list-style-type: none"><li>• Introduce the systems</li><li>• Explain the design, function and operating principles of the following:<ul style="list-style-type: none"><li>○ Hydro-mechanical and electronically controlled fuel systems</li><li>○ Oil system</li><li>○ Ignition system</li><li>○ Cooling systems</li><li>○ Tanks</li><li>○ Pump types</li><li>○ Filters</li></ul></li></ul>
<b>Jet engine cycle:</b> <ul style="list-style-type: none"><li>• Introduce the jet engine cycle</li><li>• Explain the basic operating principals, including:<ul style="list-style-type: none"><li>○ Four stages of the cycle</li><li>○ Basic pressure temperature and velocity changes</li></ul></li></ul>
<b>Additional gas turbine engine systems:</b> <ul style="list-style-type: none"><li>• Introduce the additional gas turbine engine systems</li><li>• Explain the basic operating principals of the following:<ul style="list-style-type: none"><li>○ Thrust augmentation systems</li><li>○ Reheat and main components</li><li>○ Various types of thrust reverser systems</li></ul></li><li>• Explain the pressure, temperature and velocities at different points within the system</li></ul>
<b>Review:</b> <ul style="list-style-type: none"><li>• Review the basic operating principals of gas turbine engine systems</li></ul>
<b>Formative assessment:</b> <ul style="list-style-type: none"><li>• Formative assessment of the basic operating principals of gas turbine engine systems</li></ul>

## JET ENGINE PROPULSION

### Activity 1:

- Cadets should visit an aerospace museum, or online resource, to see for themselves the different type of jet engines and their applications

### Activity 2:

- Cadets should visit an airfield or maintenance faculty to see engines and propellers in a working environment

<b>JET ENGINE PROPULSION</b>
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<b>Subject review:</b>
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- Review of the subject and activities

<b>Preparation for summative assessment:</b>
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- Prepare for Online Assessment on Utlilearn

<b>JET ENGINE PROPULSION</b>	
<b>Assessment Criteria for Each Learning Outcome</b>	
<b>Subject</b>	<b>Jet Engine Propulsion</b>
Classification	Senior Cadet / Master Air Cadet
BTEC Aviation Studies	Unit 11: Principles of Jet Engine Propulsion
<b>Learning Outcome</b>	<b>Assessment Criterion</b>
The learner will:	The learner can:
LO1: Know operating principles of a jet engine cycle and its relevant systems	P1: Identify main sections of jet engines
	P2: Explain the jet engine cycle
	P3: Describe the function of the components of gas turbine engine systems
	P4: Describe main components of jet engine fuel systems
LO2: Know types of jet engine	P5: Identify turbo-jet engines
	P6: Describe the difference between turbo-prop and turbo-shaft engines
LO3: Understand operating principles of gas turbine engine systems	P7: Describe the operation of the vectored thrust
	P8: Identify types of jet engine thrust augmentation systems
	P9: Identify components of jet engine reheat systems
	P10: Identify components of jet engine thrust reverser systems

ACO Aviation Training Syllabus

**Glossary of Terms**

<b>Term</b>	<b>Meaning</b>
Learning outcomes	What a cadet is expected to know, understand or be able to do.
Assessment criteria	The standard a cadet is expected to meet to demonstrate that a learning outcome, or set of learning outcomes, has been achieved.
Guidance to instructors on subject delivery	A programme that gives the instructor guidance on the content and suggested order of delivery for a particular subject. It will include the learning outcomes, what should be covered to achieve those outcomes and any relevant practical activities.
Formative assessment	Regular and informal assessment that provides feedback throughout the learning process that supports the cadet's progress. This can take the form of checks of understanding through question and answer sessions or demonstration of an activity.
Summative assessment	Assessment of learning by an HQ Air Cadets paper-based examination or online assessment. A cadet will have to correctly answer a question that directly relates to an assessment criterion.
Examination	Paper-based exclusive choice question paper for the old syllabus subjects for Leading, Senior and Master Air Cadet.
Online assessment	Online assessment process, accessed through Utlilearn, for Leading Cadet from Sep 10 and Senior and Master Air Cadet from Sep 11.
Lesson check of understanding	Throughout and at the end of each lesson there should be a check of understanding. At the start of the next lesson, the previous check of understanding should be reviewed in order to consolidate previous learning before moving on to new learning.
Check of understanding for First Class Cadet	This is a competence-based assessment process for First Class Cadet which should test understanding through practical demonstration, activity observation, oral questioning and inspection.