Advisory Circular

AC66–2.8

Original

01 June 2015

Aircraft Maintenance Engineer Licence—
Examination Subject 8
Turbine Engines

General

Civil Aviation Authority Advisory Circulars contain information about standards, practices, and procedures that the Director has found to be an **Acceptable Means of Compliance (AMC)** with the associated rule.

An AMC is not intended to be the only means of compliance with a rule, and consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices, or procedures are found to be acceptable they will be added to the appropriate Advisory Circular.

An Advisory Circular may also include **guidance material (GM)** to facilitate compliance with the rule requirements. Guidance material must not be regarded as an acceptable means of compliance.

Purpose

This Advisory Circular provides an AMC for the syllabus content in respect of written examinations for Subject 8 (Turbine Engines).

This Advisory Circular also provides GM for recommended study material in respect of the examination syllabus in this Advisory Circular.

Related Rules

This Advisory Circular relates specifically to Civil Aviation Rule Part 66 Subpart B — Aircraft Maintenance Engineer Licence.

General information on Aircraft Maintenance Engineer Licence (AMEL) examination requirements is contained in Advisory Circular AC66-1.

Change Notice

No change.

Table of Contents

Rule 66.57 Eligibility Requirements

Rule 66.57(a)(2) requires an applicant for an AMEL to have passed written examinations, that are acceptable to the Director, relevant to the duties and responsibilities of an aircraft maintenance engineer in the category of licence sought.

The written examinations acceptable to the Director for Subject 8 (Turbine Engines) should comply with the syllabus contained in this Advisory Circular. Each examination will cover all topics and may sample any of the sub-topics.

The new syllabus has been developed after extensive industry consultation and the objectives reflect the knowledge required of current technology and international best work practice.

Examination Overview: Subject 8

Subject 8 (Turbine Engines) is a three-hour, closed book, written examination containing 100 questions. The pass mark is 75 percent.

Application to sit an examination may be made directly to Aviation Services Limited (ASL). Refer to http://caanz.aspeqexams.com/ for examination information.

An AME sample question booklet with 15 representative questions pertaining to this subject is available for purchase from ASL.

General Examining Objective

The objective of the examination is to determine that the applicant for an AMEL has adequate knowledge of Turbine Engines to permit the proper performance, supervision and certification of aircraft maintenance at a level commensurate with the privileges of the various AMEL categories.

Knowledge Levels

LEVEL 1: A familiarisation with the principal elements of the subject.

Objectives: The applicant should:

1. be familiar with the basic elements of the subject.
2. be able to give simple descriptions of the whole subject, using common words and examples.
3. be able to use typical terms.

LEVEL 2: A general knowledge of the theoretical and practical aspects of the subject.

An ability to apply the knowledge.

Objectives: The applicant should:

1. be able to understand the theoretical fundamentals of the subject.
2. be able to give a general description of the subject using, as appropriate, typical examples.
3. be able to use mathematical formulae in conjunction with physical laws describing the subject.
4. be able to read and understand sketches, drawings and schematics describing the subject.
5. be able to apply his/her knowledge in a practical manner using detailed procedures.

LEVEL 3: A detailed knowledge of the theoretical and practical aspects of the subject.

A capacity to combine and apply the separate elements of knowledge in a logical and comprehensive manner.

Objectives: The applicant should:

1. know the theory of the subject and the interrelationships with other subjects.
2. be able to give a detailed description of the subject using theoretical fundamentals and specific examples.
3. understand and be able to use mathematical formulae related to the subject.
4. be able to read, understand and prepare sketches, simple drawings and schematics describing the subject.
5. be able to apply his/her knowledge in a practical manner using manufacturer’s instructions.
6. be able to interpret results and measurements from various sources and apply corrective action where appropriate.

Recommended Study Material

The publication list below provides guidance material for suitable study references for the overall syllabus content. However, applicants may have to conduct further research using other references or sources (including the internet) or attend a formal course in order to gain a comprehensive understanding of all sub-topics in the syllabus.

Where applicable, publication references have been placed below each main topic or sub topic heading in this syllabus.

Publication List

Study Ref	Book Title	Author	ISBN
1	Aircraft Gas Turbine Powerplants	Jeppesen	0-89100-255-3
2	Aviation Maintenance Technician Series, Powerplant	Dale Crane	1-56027-410-7
3	The Jet Engine	Rolls Royce	0-902121-2-35
4	Aircraft Propellers and Control	Frank Delp	0-89100-097-6
5	Dictionary of Aeronautical Terms	Dale Crane	1-56027-287-2

Syllabus Layout

Topic Numbering – left hand column

The syllabus is set out by topics, each of which is identified by a single-digit number. Each topic is divided into a number of sub-topics, which are identified by two-digit numbers: the first and second digits of which refer to the topic and the sub-topic respectively.

Each sub-topic is further sub-divided into one or more sub-sub-topics, which are identified by three-digit numbers. Where applicable, sub-sub-topics may be further subdivided into paragraphs that are identified by four/five digit alphanumeric sequences.

The three-digit sub-sub-topic numbers shown in the left hand column are used in the ‘knowledge deficiency reports’ to provide feedback on individual examinations.

Objective description – middle column

The middle column objectively describes each sub-sub-topic by stating, in plain language, its subject matter and the type of performance or activity required. The objectives are intended to be simple, unambiguous, and clearly-focussed, outcomes to aid learning.

Knowledge levels – right hand column

The right hand column specifies the knowledge level for each sub-topic heading. The three levels of knowledge used in this syllabus are described above. Note that the knowledge levels indicate the depth of knowledge required NOT its safety importance.

Syllabus: Subject 8 (Turbine Engines)

1	Fundamentals	
1.1	**Thermodynamics and the Gas Turbine Engine Cycle** *Study Ref. 1 & 2*	
1.1.1	Define each of the following terms and describe their application to gas turbine engine operation: a. Bernoulli's Theorem b. Brayton constant pressure Cycle c. Open cycle d. Closed cycle e. Kinetic energy f. Potential energy g. Thermodynamic laws	2
1.2	**Gas Turbine Engine Types** *Study Ref. 1,2 & 3*	
1.2.1	Compare the relative advantages and disadvantages of piston versus gas turbine engines for aircraft propulsion.	1
1.2.2	Describe the basic constructional arrangements of the following engine types: a. Turbofan b. Ducted fan (high bypass ratio) c. Prop fan d. Turbojet e. Turboprop f. Turbo-shaft	2
1.2.3	Compare the relative advantages and disadvantages of each of the above engines over each other.	1
1.2.4	Give examples of aircraft types where the above engines are used in civil operations.	1
1.2.5	Identify engines that fall into either the thrust-producing or torque-producing category.	1
1.2.6	Specify the approximate ratio of jet thrust to propeller thrust that may be obtained from a modern turboprop engine.	2

1.3	**Mechanical Arrangements of Gas Turbines** *Study Ref. 1,2 & 3*	
1.3.1	Describe the following mechanical arrangements of gas turbine engines: a. Double-entry, single-stage, centrifugal, turbo-jet b. Single-entry, two stage, centrifugal, turbo-propeller c. Twin-spool axial flow turbo-propeller d. Single axial flow compressor, free turbine drive turbo-prop e. Single-spool, axial flow, turbo-jet f. Twin-spool by-pass turbo-jet (low by-pass ratio) g. Aft fan, turbo-jet h. Triple-spool, front fan turbo-jet (high by-pass ratio)	1
1.3.2	Describe the referencing system or station numbering system used for identifying component or accessory placement on a gas turbine engine.	2
1.3.3	Describe the following factors that are specific to turbo-prop engines: a. Design and operation of gas coupled and gear coupled turbines b. Construction, function and layout of reduction gears c. Overspeed safety devices	1
1.4	**Engine Assemblies and Basic Construction** *Study Ref. 1,2 & 3*	
1.4.1	Identify the basic engine assemblies that make up the various types of gas turbine engine.	1
1.4.2	State how and where modularisation is used in modern engine construction.	1
1.4.3	State where the following materials may be found in modern engine construction: a. Aluminium b. Titanium c. Magnesium d. Stainless steel e. Composites f. Kevlar g. Powder metallurgy h. Ceramics i. Single crystal j. Teflon k. Nickel Alloys l. Cobalt based alloys	1
1.5	**Modern Manufacturing Processes** *Study Ref. 1,2 & 3*	
1.5.1	Outline the following modern manufacturing processes and give examples of where each is used: a. Forging using powder metals b. Investment casting c. Lost wax casting d. Single crystal casting	1

2	Engine Performance	
	ATA 71	
2.1	**Power and Performance** *Study Ref. 1& 2*	
2.1.1	Define the following conditions/ terms; describe the relationship between them, and their application to engine operation: a. Choked nozzle thrust b. Equivalent shaft horsepower c. Gross thrust d. Net thrust e. Resultant thrust f. Specific fuel consumption (SFC) g. Thrust specific fuel consumption (TSFC) h. Thrust distribution i. Thrust horsepower	2
2.1.2	Specify how the power output is measured on the various types of gas turbine engine.	2
2.1.3	Identify components in a gas turbine engine that produce either forward propulsive or rearward propulsive forces.	2
2.1.4	Specify how the rated thrust of an engine is derived from the calculation of forward and rearward forces.	2
2.1.5	Describe the approximate power requirements needed to drive the compressor on the various types of engine.	2
2.2	**Factors Affecting Power** *Study Ref. 1& 2*	
2.2.1	Describe, and calculate where appropriate, the following performance factors: a. Engine ratings b. Engine static thrust c. Influence of aircraft speed d. High altitude and hot climate operation e. Engine Flat rating f. Engine limitations	2
2.2.2	Specify the effects on aircraft/engine operation of atmospheric: a. Pressure b. Density c. Temperature d. Humidity	2

2.3	**Gas Turbine Efficiency and Performance Factors** *Study Ref. 1& 2*	
2.3.1	Define each of the following engine efficiencies and describe how they are derived: a. Adiabatic b. Propulsive c. Thermal	2
2.3.2	Identify factors that have a positive and negative impact on the above efficiencies.	2
2.3.3	Specify the effects that weight, diameter and compressor/turbine size has on engine efficiency.	1
2.3.4	Using graphical representation where appropriate, describe the following: a. Thrust horsepower in turbo-jet and turbo-fan engines b. Propeller thrust per shaft horsepower versus airspeed c. Propulsive efficiency versus airspeed for the various engine types d. Efficiency curves e. Effect of OAT on thrust output f. Effect of altitude on net thrust g. Effect of airspeed on net thrust h. Effects of airspeed on specific thrust and total engine airflow i. Effect of RPM on thrust j. The effects of compression ratio on thermal efficiency k. Turbine and compressor efficiency versus thermal efficiency l. Effects of turbine inlet temperature on turbine bucket life m. Thrust recovery with aircraft speed n. Effects of aircraft speed on thrust and fuel consumption o. Effects of aircraft speed on shaft horsepower and fuel consumption p. Effects of altitude on SFC	2
2.3.5	Define giving practical examples: a. By-pass ratio b. Engine pressure ratio and how/where it is measured	2
2.3.6	Identify where the various notations of P and T (e.g. Pt1) are taken in the common types of turbine engine.	1
2.3.7	Describe the conditions/characteristics relating to pressure, temperature and velocity of the gas flow as it passes through each section of the gas turbine engine.	2

3	**Engine Inlet System**		
	ATA 71 and 72		
3.1	**Inlet Duct Designs** *Study Ref. 1, 2 & 3*		
3.1.1	Specify the purpose, construction and principles of operation of the following compressor inlet ducts: a. Engine-mounted inlets b. Wing-mounted inlets c. Fuselage mounted inlets d. Subsonic inlets e. Trans-sonic inlets f. Bellmouth inlets g. Single entrance inlets	2	
3.1.2	Specify when/where each of the following intake types may be used: a. Pitot b. Divided c. External/internal compression d. Variable throat	2	
3.1.3	Describe the types of inlet normally used on the various modern gas turbine engines.	1	
3.2	**Inlet System Devices** *Study Ref. 1& 2*		
3.2.1	Describe the purpose and operation of the following inlet duct devices: a. Movable spike b. Movable plug c. Wedges d. Dump valve e. Spill valve	2	
3.3	**Inlet Duct Design and Performance Characteristics** *Study Ref. 1& 2*		
3.3.1	Explain the effects on pressure, velocity and temperature of airflow through convergent, divergent and convergent-divergent ducts.	2	
3.3.2	Identify the factors that affect inlet air density.	2	
3.3.3	Specify the effects of ram pressure recovery and the causes of inlet duct losses.	2	
3.3.4	Describe the formation and control of shock waves on high-speed ducts.	1	
3.3.5	Specify the effects of shockwaves on inlet duct efficiency.	2	
3.3.6	Describe the construction of turboprop compressor inlets.	2	
3.3.7	Describe the function and construction of compressor inlet screens and particle separators.	2	
3.3.8	Specify the purpose and operation of a vortex dissipater.	2	
3.4	**Ice Protection** *Study Ref. 1& 2*		
3.4.1	Describe the following ice protection systems and devices: a. Hot air systems – struts and intakes b. Electrical systems for intakes c. Use of oil and air bleeds d. Pressure sensor heating	2	

4	**Compressors**	
	ATA 72	
4.1	**General** *Study Ref. 1, 2 & 3*	
4.1.1	State the purpose of a compressor in a gas turbine engine.	2
4.1.2	Compare the basic differences between axial and centrifugal compressors.	2
4.1.3	Describe the merits of combined axial and centrifugal compressor combinations in small gas turbine engines.	2
4.1.4	State typical compressor pressure ratios for the various types and configurations of gas turbine engines in current civil operation.	2
4.1.5	Describe the comparative advantages and disadvantages of centrifugal and axial flow compressors.	2
4.1.6	Explain the relationship between compressor ratio and specific fuel consumption.	3
4.1.7	Describe the compressor arrangements found on the various types of modern gas turbine engine.	2
4.1.8	State how compressor design is matched to operational flexibility of the aircraft.	1
4.2	**Centrifugal Compressor Construction** *Study Ref. 1, 2 & 3*	
4.2.1	Describe the constructional features, materials and principles of operation of single and two stage centrifugal compressors.	2
4.2.2	Describe the purpose and function of following: a. Diffusers b. Impellers c. Inlet guide vanes d. Plenum chamber e. Blow-in doors f. Compressor manifold g. Outlet ducts h. Outlet elbows i. Combustion chamber inlet ducts	2
4.2.3	Define what is meant by the following compressor arrangements: a. Single stage b. Double stage c. Double entry	2
4.2.4	State the advantages of each of the above types of compressor arrangement.	1
4.3	**Centrifugal Compressor Operating Theory** *Study Ref. 1, 2 & 3*	
4.3.1	Show graphically, pressure and velocity changes through a centrifugal compressor.	3

4.4	**Axial Flow Compressor Design** *Study Ref. 1, 2 & 3*	
4.4.1	Describe the arrangement of the rotating assemblies in the following types of axial flow compressor: a. Single spool b. Dual/twin spool c. Triple spool	2
4.4.2	Specify the materials used in the construction of compressor blades, discs and cases as used in both modern and older generation engines.	1
4.4.3	State the reasons and advantages for multiple spool compressors.	2
4.4.4	Describe speed relationships between compressor sections and how these speeds may vary with changing atmospheric conditions.	2
4.4.5	Define the term “aerodynamic couple” when associated with multi spool compressors.	1
4.4.6	Specify the reasons for counter-rotation of spools in some compressor arrangements.	1
4.4.7	Describe the following features of axial flow compressors: a. How airflow compression is achieved throughout all stages of the compressor b. The function and arrangement of stator and rotor sections c. Compressor coupling and turbine drive arrangements d. Gas coupling e. Blade shape and size f. Various blade mounting and locking arrangements g. Airflow over the various sections of a blade	2
4.5	**Blade Design Characteristics** *Study Ref. 1, 2 & 3*	
4.5.1	Define the following terms associated with a compressor blade: a. Length b. Chord c. Thickness d. Aspect ratio e. Trailing edge f. Camber g. Tip profile	2
4.5.2	Specify the reasons for blade shrouding, mid-span shrouding and fan blade supports.	2
4.5.3	Describe the following factors relating to compressor blades: a. The reason for blade twist (stagger angle) b. Why the blade base area has more camber than the tip c. Why the trailing edge of a blade is knife-edge thin	2

4.6	**Axial Flow Compressor Operating Theory** *Study Ref. 1, 2 & 3*	
4.6.1	For various types of compressor arrangements, identify; Nc, N1, N2, and N3.	1
4.6.2	State the reasons why axial flow compressors, compared to centrifugal compressors, have a higher number of stages. State the typical pressure rise between the axial stages.	2
4.6.3	Show graphically the relationship between pressure and velocity in an axial flow compressor.	2
4.6.4	Describe the purpose of compressor taper.	2
4.6.5	Interpret a vector diagram of interstage compressor airflow and the cascade effect.	2
4.6.6	Describe cycle pressure ratio.	2
4.6.7	Describe the construction, operation and pressure ratios associated with low. Medium and high bypass fans.	1
4.6.8	State typical compression ratios achieved in modern axial flow compressors.	1
4.6.9	State the factors that affect compression ratio.	1
4.7	**Rotors, Stators and Associated Devices** *Study Ref. 1 & 2*	
4.7.1	Specify the purpose and function of the following: a. Fixed inlet guide vanes b. Rotor blades c. Stator blades d. Variable inlet guide vanes e. Variable stator blades	2
4.8	**Stator Construction** *Study Ref. 1, 2 & 3*	
4.8.1	Describe the following features relating to stator assemblies: a. Blade design and construction b. Methods of securing blades c. Shroud rings d. Blade stiffening bands	2
4.9	**Combination Compressors**	
4.9.1	Describe the purpose, constructional features, materials, operating principles, advantages and disadvantages of combined axial and centrifugal compressors as used in small gas turbine engines.	1

4.10	**Compressor Stall Conditions** *Study Ref. 1, 2 & 3*	
4.10.1	State the conditions that are commonly known to produce compressor stall with particular regard to the following points: a. Compressor maintenance b. Blade damage c. Intake damage/restriction d. Engine handling/operation e. Fuel scheduling	2
4.10.2	Describe the effects on compressor operation of distorted air entry into the intake of a gas turbine engine.	2
4.11	**Indications and Effects of Compressor Stall** *Study Ref. 1, 2 & 3*	
4.11.1	State the common indications of compressor stall.	2
4.11.2	Describe the types of damage that can occur to an engine that has suffered varying degrees of compressor stall.	2
4.12	**Compressor Stall Theory** *Study Ref. 1, 2 & 3*	
4.12.1	Describe the relationship between compression ratio and mass airflow as it is affected by the following: a. Slight inlet restriction b. Restricted exhaust c. The effects of combustor and turbine back pressures	2
4.12.2	Describe using vector diagrams how a compressor stall occurs.	2
4.12.3	Specify how compressor pressure ratio influences blade angle of attack through a compressor.	2
4.12.4	Compare the difference between compressor surge and compressor stall.	2
4.13	**Interpretation of Compressor Stall Graphs** *Study Ref. 1, 2 & 3*	
4.13.1	Interpret a stall margin graph understanding the following terms: a. Stall or surge zone b. Surge stall line c. Stall margin area d. Normal operating or working line e. Design point for cruise f. RPM lines g. Unstable area h. Zone of poor efficiency	2
4.13.2	Interpret a stall map.	1

4.14	**Stall Management** *Study Ref. 1, 2 & 3*	
4.14.1	Specify how the various stall control systems reduce the possibility of compressor stall.	2
4.14.2	Describe the purpose, construction, location, operation, rigging and maintenance of the following stall control devices and on what engines they may typically be found: a. Variable angle compressor vane system b. Variable angle inlet guide vane system c. Variable and non-variable bleed values d. Bleed band	2
4.14.3	Specify opening and closing parameters for compressor bleed devices during engine operation from start to max power.	2
4.14.4	Describe new advances in compressor design to manage stall, including the following: a. Blade design b. Active clearance control c. Axial/centrifugal flow compressors	1
4.15	**Compressor – Diffuser Section** *Study Ref. 1, 2 & 3*	
4.15.1	Describe the purpose, design and pressure/velocity values of the compressor-diffuser section.	1
4.16	**Compressor Maintenance** *Study Ref. 1, 2 & 3*	
4.16.1	Describe typical compressor wash and blast cleaning processes.	2
4.16.2	Describe typical defects that are found on compressor blades.	2
4.16.3	State typical causes of the above defects and, where appropriate, what measures may be taken to minimise this damage.	2
4.16.4	Detail the critical sections of compressor blades that may be susceptible to the above damage.	3
4.16.5	Describe surface coating processes for blades.	1
4.16.6	Describe typical in-service compressor inspection techniques.	2
4.16.7	Describe typical in-service blending repairs to compressor blades.	2
4.16.8	Specify the effects of a dirty, worn or damaged compressor on SFC and power output.	2
4.17	**Compressor Balancing** *Study Ref. 1, 2 & 3*	
4.17.1	Outline the fundamentals of compressor balancing with particular regard to: a. Static and dynamic balancing b. Redistribution, addition and removal of weight c. Maintaining compressor balance during field repair or replacement of compressor blades	1

5	**Combustion Section**	
	ATA 72	
5.1	**General Requirements**	
	Study Ref. 1, 2 & 3	
5.1.1	Outline the general functions, purpose and requirements of a gas turbine combustion chamber.	2
5.2	**Combustion Chamber Types**	
	Study Ref. 1, 2 & 3	
5.2.1	Describe the, constructional features, materials and principles of operation of the following combustion chambers: a. Annular b. Multiple Can c. Can-annular d. Reverse-flow annular	1
5.2.2	State the advantages and disadvantages of each type of combustion chamber.	1
5.2.3	Identify engines where each type of chamber may be found. Give reasons for their use.	1
5.3	**Combustion Chamber Theory**	
	Study Ref. 1, 2 & 3	
5.3.1	Define the following terms: a. Combustion fuel/air ratio b. Flame stabilisation c. Flame temperatures d. Vortex generation e. Overall fuel/air ratio f. Primary zone airflow g. Secondary zone airflow h. Dilution and cooling i. Gas expansion and acceleration j. Combustor efficiency k. Gas flow reversal	2
5.4	**Combustion Chamber Operation**	
	Study Ref. 1, 2 & 3	
5.4.1	Describe the purpose, construction and operation of swirl chambers, air shrouds and discharge orifices.	2
5.4.2	Specify the uses of primary, secondary and tertiary airflow through or around a combustion chamber.	2
5.4.3	Identify how flameout is caused and prevented.	2
5.4.4	Explain lean and rich mixture flameout.	3
5.4.5	Identify types and causes of combustor generated emissions and pollutants.	2
5.4.6	Identify materials that may and may not be used for marking hot section components.	2

5.5	**Combustion Chamber Defects and Maintenance** *Study Ref. 1, 2 & 3*	
5.5.1	Identify the causes of the following combustion section defects and describe appropriate remedies: a. Combustion chamber cracks b. Pits and corrosion c. Burned and buckled areas d. Thermal stresses e. Fuel nozzle and spray pattern defects f. Carbonisation g. Hot-spots	2
5.5.2	Describe typical weld techniques and precautions for repairs to combustion chamber components.	2
5.5.3	Specify how carbon should be removed from the surface of burners and combustion chambers during maintenance.	2
5.6	**Fuel Nozzles** *Study Ref. 1, 2 & 3*	
5.6.1	Describe the purpose, construction and principles of operation of the following assemblies: a. Duplex (dual orifice) atomising fuel nozzles b. Simplex (single orifice) atomising fuel nozzles c. Spill type atomising fuel nozzles d. Vaporising type nozzles	2
5.6.2	Describe the purpose of a flow divider in a duplex nozzle and how it operates.	2
5.6.3	Compare the principal advantages of a duplex nozzle over other types of nozzle.	1

6	**Turbine Section**	
	ATA 72	
6.1	**Turbine Blades** *Study Ref. 1, 2 & 3*	
6.1.1	Describe the principles of operation and characteristics of the following turbine blade design: a. Impulse b. Impulse-reaction c. Reaction	2
6.1.2	Identify the most common type of turbine blade design and give reasons why this type of blade is preferred.	1
6.1.3	Specify how a turbine blade extracts energy from the gas stream and drives the wheel.	2
6.1.4	Describe the shape of the nozzle/blade ducts found in each type of turbine blade arrangement.	2
6.2	**Purpose and Functions of Nozzle Guide Vanes** *Study Ref. 1, 2 & 3*	
6.2.1	Explain the purpose and function of nozzle guide vanes and how the driving force for impulse and impulse reaction turbines is obtained from the gas flow.	2
6.2.2	Describe how nozzle guide vanes are mounted and retained.	2
6.2.3	Explain the gas flow pattern through the nozzle and blade assembly with particular emphasis on static pressure and velocity.	2
6.2.4	Describe the losses that occur in a nozzle and turbine assembly.	2
6.2.5	Distinguish the difference between the turbine power extraction requirements for turbo-jet, turbo-fan and turbo-prop engines.	1
6.2.6	Specify the reasons for compressor-turbine matching and how it is achieved.	2
6.2.7	Describe a radial inflow turbine and where it would normally be used.	1
6.3	**Turbine Components** *Study Ref. 1, 2 & 3*	
6.3.1	Describe the function and constructional properties of typical materials used in the fabrication of the following turbine assembly components: a. Case b. Nozzle c. Shroud ring d. Tip shrouds e. Wheel f. Air seal g. Diaphragms h. Cones	1

6.4	**Turbine Design Characteristics**	
	Study Ref. 1, 2 & 3	
6.4.1	Describe the following: a. How turbine blades and nozzles are cooled and modern cooling techniques such as film cooling b. Turbine case cooling c. The various methods of turbine blade to disc attachment including: d. Fir tree root (two types) e. De Laval bulb root f. BMW Hollow blade g. N1, N2 and N3 turbine arrangement h. Compressor/turbine coupling shaft arrangements i. Knife edge seals j. Turbine blade twist and stagger/incidence angle	2
6.4.2	Specify how radial inward flow of gasses is prevented at the turbine disk rim.	2
6.4.3	Describe the reasons for shrouded turbine blades.	2
6.4.4	State the properties of typical materials used in the fabrication of turbine discs.	2
6.5	**Turbine Section Defects**	
	Study Ref. 1, 2 & 3	
6.5.1	Describe the following turbine section defects, where they are likely to occur, possible causes and the likely effects on engine performance: a. Stress rupture cracks of blades b. Bowing, cracking and warping of nozzles c. Gas path erosion d. Turbine blade-untwist e. Curling of blade tips f. Blade deformation g. Blade burning h. FOD i. Disk pitting	2
6.5.2	Describe a turbine engine cycle (Start/Stop) and its importance in determining turbine assembly life.	2
6.5.3	Identify the causes and effects of turbine blade stress and state the factors that determine blade creep.	2
6.5.4	Define primary, secondary and tertiary blade creep and when each is likely to occur.	2
6.6	**Turbine Section Maintenance**	
	Study Ref. 1, 2 & 3	
6.6.1	Describe the following: a. The purpose of turbine vibration analysis and how this would typically be carried out in service b. Measurement of blade/shroud tip clearances c. Torquing methods for rotating assembly fastening devices	2

7	Exhaust Section	
	ATA 78	
7.1	**General** *Study Ref. 1, 2 & 3*	
7.1.1	Describe the purpose, constructional features, materials and operating principles of a gas turbine exhaust system including the following: a. Cone or exhaust plug b. Radial support struts c. Cooling shroud d. Gas flow straighteners e. Propelling nozzle f. Tail pipe g. Tail pipe tabs h. Insulating blankets	1
7.1.2	Describe how the characteristics of the gas flow are affected in terms of pressure, temperature and velocity by the exhaust section components identified above.	2
7.2	**Exhaust Section Operating Theory** *Study Ref. 1, 2 & 3*	
7.2.1	Describe the various methods and reasons for internal and external hot/cold gas mixing.	2
7.2.2	State the purpose and principles of operation of the following nozzle types: a. Convergent b. Convergent-divergent c. Variable area d. Divergent (rotorcraft operation)	2
7.2.3	Explain what is meant by a choked nozzle and its effects on engine performance. Also determine the pressure ratio across a nozzle for a choked condition.	3
7.2.4	Describe the nature of the gas flow in terms of pressure distribution as it exits the propelling nozzle.	2
7.2.5	Specify the pressure, velocity and temperature changes that occur in the various types of exhaust system.	2
7.3	**Thrust Reversers** *Study Ref. 1, 2 & 3*	
7.3.1	Describe the functions, constructional features, materials, principle of operation and motive power of the following types of engine thrust reverser and their derivatives: a. Aerodynamic blockage (fan, blocker door, cascade vane types) b. Mechanical blockage (target and clamshell types)	1
7.3.2	Describe the effects of thrust reverser operation on the following performance characteristics: a. Engine efficiency b. Magnitude of reverse thrust produced c. Re-ingestion of exhaust gasses	2
7.3.3	In relation to the overall braking effectiveness of an aircraft, specify the amount of braking a thrust reverser may provide.	2

7.3.4	Describe the following: a. Safety system features b. Control interlocks c. Typical reverser position indication system	2
7.4	**After-Burning (reheat)** *Study Ref. 1, 2 & 3*	
7.4.1	Outline the broad principles and reasons for afterburning on some jet aircraft.	1

8	Engine Sub-Assemblies, Systems and Componentry	
	ATA 72 and 83	
8.1	**Bearings** *Study Ref. 1, 2 & 3*	
8.1.1	Identify the types of bearings used in gas turbine engines and describe their constructional features and principles of operation including the following: a. Ball thrust b. Roller c. Hydrodynamic or slipper type bearings d. Bearing housings e. Races f. Self alignment features g. Oil damping	2
8.1.2	Compare the advantages and disadvantages of ball or roller anti friction bearings when used in gas turbine engines.	2
8.1.3	Describe typical bearing arrangements in the various types of engine.	2
8.1.4	Describe typical primary loads and forces acting on the main bearings throughout the engine.	2
8.2	**Bearing Handling and Maintenance** *Study Ref. 1, 2 & 3*	
8.2.1	Specify acceptable handling procedures for engine bearings with particular regard to: a. Cleaning b. Inspection c. The "feel test" in comparison with a new item d. Spinning e. Air drying f. Degreasing g. Magnetism check h. Bearing race installation (heating and chilling)	2
8.3	**Bearing Distress Terms** *Study Ref. 1, 2 & 3*	
8.3.1	Explain the following bearing defects and how each may have occurred: a. Abrasion b. Brinelling c. Burning d. Burnishing e. Corrosion f. Galling g. Fretting h. Peening i. Grooving j. Guttering k. Inclusion l. Pitting m. Scoring n. Spalling	2

8.4	**Bearing Seals**	
	Study Ref. 1, 2 & 3	
8.4.1	Describe the purpose, construction and principles of operation of typical gas turbine engine bearing seals with particular regard to the following: a. Carbon-ring seals b. Carbon-face seals c. Seal packs d. Slingers e. Seal drains f. Labyrinth seals g. Pressurised seals h. Source of sealing air	2
8.5	**Gearboxes**	
	Study Ref. 1, 2 & 3	
8.5.1	Describe the constructional features and maintenance requirements of the following: a. Reduction gearboxes b. Accessory gearboxes c. Combining gearboxes	1
8.5.2	Specify the locations and drive arrangements for the above gearboxes as fitted to various engine types.	1
8.5.3	State the types of gears commonly found in each gearbox.	1
8.5.4	Describe typical reduction methods.	1
8.5.5	Identify the respective gearbox each of the following components and accessories may be driven off for various engine types: a. Starter b. Governor c. Fuel control unit d. Oil pumps e. Torque meter pump f. Air Compressor g. Tachometer	1
8.6	**Alternator Drives**	
	Study Ref. 1, 2 & 3	
8.6.1	State the basic requirements, arrangements and principles of operation of the following. a. Constant speed drives (CSD) b. Integrated drive generators (IDG)	1
8.7	**Torque Meter Systems**	
	Study Ref. 1, 2 & 3	
8.7.1	State the principles of operation of a hydraulic torque metering system.	1
8.7.2	State the principles of operation of a torque-shaft torque metering system.	1
8.7.3	State what other engine systems use output signals from a torque metering system.	1
8.7.4	Describe the calibration of a typical torque meter system as found in a turbo-prop or turbo-shaft engine. State the units in which these systems are calibrated.	2

9	Fuels and Lubricants	
9.1	**Properties of Fuels** *Study Ref. 1, 2 & 3*	
9.1.1	Describe the following properties in relation to gas turbine fuels: a. Calorific value b. Corrosion characteristics c. Energy per lb or kg d. Specific gravity e. Vapour pressure f. Fire hazard g. Flash point h. Fuel icing	2
9.1.2	Compare the differences between the various types of jet fuel.	1
9.1.3	Describe the purposes of additives such as anti-icing and anti-microbiological in jet fuels.	1
9.1.4	Identify the basic requirements of gas turbine fuels when used in engines with various types of fuel nozzle.	1
9.2	**Fuel Handling** *Study Ref. 1, 2 & 3*	
9.2.1	State the ground handling requirements and the safety precautions to be observed with the use of gas turbine engine fuels.	2
9.2.2	Describe the fuel system markings for jet fuels.	2
9.3	**Fuel Contamination** *Study Ref. 1, 2 & 3*	
9.3.1	Specify the various forms of fuel contamination, including the following: a. Foreign particles b. Microbial growth c. Other grades/types of fuels d. Sediment e. Water	2
9.3.2	Describe the susceptibility of gas turbine fuels to water contamination over other types of aviation fuels.	2
9.3.3	Describe methods of fuel system contamination detection and control.	2

9.4	**Lubricants** *Study Ref. 1, 2 & 3*	
9.4.1	State the basic requirements of a gas turbine lubricant and define the following lubricant characteristics: a. Viscosity b. Viscosity index	1
9.4.2	Describe the following desirable characteristics of synthetic based lubricants: a. Anti-foaming quality b. High flash point c. Low lacquers and coke deposit d. Low pour point	1
9.4.3	Describe the composition and special characteristics of gas turbine lubricating oils including why synthetic is preferred over mineral oil.	1
9.4.4	Specify the toxicity of engine oils and additives and precautions when handling oils.	2
9.4.5	Describe precautions associated with mixing of turbine oils.	2
9.4.6	Specify the effects of using oxidation inhibitors in oils.	2
9.4.7	Identify by manufacturer's designation and/or Mil Spec the common synthetic oils used in modern gas turbine engines.	2
9.4.8	Specify the following effects of lubricants on safety, handling and maintenance procedures: a. Flammability b. Contamination by water or dirt c. Sampling	2

10	Fuel Control and Metering Systems	
	ATA 73	
10.1	**Basic Requirements and Operating Principles**	
	Study Ref. 1, 2 & 3	
10.1.1	State the basic requirements, arrangements and principles of operation of gas turbine engine fuel control/metering systems, including the following: a. Acceleration scheduling and control b. Air density/altitude/OAT/airspeed compensation c. Overspeed governing d. Power limiting e. Shutdown control f. Starting control g. Temperature Limiting	2
10.1.2	Specify the fuel control input signals that are a measure of air mass flow through an engine.	2
10.1.3	Identify the common fuel control unit parameters sensed during normal engine operation.	2
10.2	**System Components**	
	Study Ref. 1, 2 & 3	
10.2.1	Specify the relationship, location and function of the following gas turbine engine fuel control system components: a. Engine sensing components b. Fuel control unit (hydro pneumatic, hydro mechanical and electro-hydro mechanical) c. Fuel filters (HP and LP) d. Fuel heater e. Governors and limiting devices f. Main fuel pumps (HP and LP) g. Valves (throttle/pressurising/dump/shutoff) h. Fuel boost pumps i. Refuel/de fuel, feed, jettison and crossfeed systems j. Fuel valve operation and control	2
10.2.2	Describe the operation of various positive displacement type fuel pumps and where each would typically be used.	1
10.2.3	Describe the construction, operation and control of a variable displacement fuel pump.	1
10.2.4	State why high fuel pressures are required in a gas turbine fuel system.	2
10.3	**Full Authority Digital Engine Control System (FADEC)**	
	Study Ref. 1, 2 & 3	
10.3.1	Compare the advantages of FADEC over hydromechancial engine control.	2
10.3.2	Specify the key purpose of having a two channel FADEC system.	2
10.3.3	Describe reversionary modes.	2
10.3.4	Specify the purpose of the “Rating” or “Identification” plug.	2
10.4	**Fuel System Maintenance**	
	Study Ref. 1, 2 & 3	
10.4.1	From given information, identify the effects of faults in components of a fuel control system and determine fault location and rectification requirements of system faults.	2

11	**Engine Ignition Systems**	
	ATA 74	
11.1	**Types of Ignition Cycle** *Study Ref. 1, 2 & 3*	
11.1.1	Describe the construction and principles of operation of the following types of gas turbine engine ignition system: a. Intermittent duty type b. Continuous duty circuit c. Auto ignition	1
11.2	**Classification of Capacitor Ignition Systems** *Study Ref. 1, 2 & 3*	
11.2.1	Describe the differences and operating principles of the following ignition systems: a. Intermittent duty low-tension system with DC voltage input b. Extended duty low tension c. High tension, intermittent duty, AC input	1
11.2.2	Compare the advantages and disadvantages of the following: a. AC versus DC input systems b. High tension versus low-tension systems	1
11.2.3	Describe why gas turbine engines require high-energy ignition systems.	1
11.3	**Ignition System Requirements** *Study Ref. 1, 2 & 3*	
11.3.1	State the basic requirements, arrangements and principles of operation of the following ignition systems and components: a. Harnesses b. High voltage AC input c. Igniter plug types including the constrained-gap type d. Glow plugs e. Low voltage DC input	1
11.3.2	Describe the construction and principles of operation of a high and low-tension igniter plug.	2
11.3.3	Specify how radio noise suppression is effected in a gas turbine ignition system.	2
11.4	**Ignition System Maintenance** *Study Ref. 1, 2 & 3*	
11.4.1	State the safety requirements during servicing and maintenance of engine ignition systems.	2
11.4.2	From given information, identify the effects of faults in components on engine ignition systems.	2
11.4.3	Describe the susceptibility of igniter plus to fouling when compared to conventional spark plugs.	1

12	**Lubrication Systems**	
	ATA 72	
12.1	**Basic System Requirements** *Study Ref. 1, 2 & 3*	
12.1.1	Describe the basic requirements, arrangements and principles of operation of typical gas turbine engine lubrication systems.	1
12.2	**Lubrication System Components** *Study Ref. 1, 2 & 3*	
12.2.1	Describe the relationship, location, function and principles of operation of the following gas turbine engine lubrication system components: a. Oil cooler b. Oil cooler baffles c. Oil-fuel and oil-air heat exchangers d. Oil filters/screens (pressure and scavenge) e. Oil jets f. Oil pumps (pressure and Scavenge) g. Gear and gerotor type pumps h. Total loss and micro-metering systems i. Oil system chip detectors and magnetic plugs j. Oil tanks k. Breather (including centrifugal type) and pressurisation systems l. Vent check valves m. Scavenge subsystem n. Valves (by-pass/check/relief) o. Vent subsystem (air/oil separators) p. Oil fed engine anti-ice systems	2
12.2.2	Describe the function of lubricating oil in cooling critical engine components such as bearings and seals.	2
12.3	**Maintenance and Trouble Shooting** *Study Ref. 1 &, 2*	
12.3.1	From given information, determine the effects of faults in components in a lubrication system with particular regard to high/low pressure and temperature indications.	3
12.3.2	Detail the factors that affect oil consumption in a gas turbine engine.	3
12.4	**SOAP and Wear Debris Analysis Programmes** *Study Ref. 1, 2 & 3*	
12.4.1	Describe spectro oil analysis programmes used to monitor the internal health of a gas turbine engine.	1

13	Engine Air and Cooling Systems	
	ATA 75	
13.1	**System Operation** *Study Ref. 1, 2 & 3*	
13.1.1	Outline the basic requirements, arrangements and principles of operation of gas turbine engine air distribution and anti-ice control systems, including the following: a. Internal cooling b. Sealing c. External air services	1
13.1.2	Describe the relationship, location and operation of the following: a. Air distribution/external services components b. Air starting system components c. Anti-icing system components d. Engine internal cooling/sealing system components	2
13.1.3	Identify the common source of bleed air and the effects of bleed air operation on engine performance.	2
13.1.4	Describe turbine case cooling covering the following areas: a. The function of the turbine case cooling system. b. The differences between active and passive cooling. c. The factors that could be used in the control of a turbine case cooling system. d. The effect of the turbine case cooling system becoming inoperative on a long distance flight.	2
13.2	**Air System Maintenance** *Study Ref. 1, 2 & 3*	
13.2.1	From given information, identify the effects of faults in components on internal cooling/sealing, anti-icing, anti-surge bleed and air distribution systems.	2

14	Indicating and Instrument Systems	
	ATA 77	
14.1	**Basic Requirements** *Study Ref. 1, 2 & 3*	
14.1.1	Outline the basic requirements, methods of operation, relationship and function of the following typical engine instrument systems: a. Flow measuring instruments (pressure/volume, fuel and mass air flow sensing types) b. Mechanical measuring instruments (engine RPM, torque and vibration) c. Pressure measuring instruments (oil and fuel) d. Power measurement (N1, EPR, engine turbine discharge pressure or jet pipe pressure) e. Temperature measuring instruments	1
14.2	**Gas flow Temperature Measurement** *Study Ref. 1, 2 & 3*	
14.2.1	Define the following terms and what the significance of each is on various engines: a. TIT b. ITT c. TOT d. EGT/TGT e. JPT f. TET	2
14.3	**Calibration and Testing of Temperature Indicating Systems** *Study Ref. 1, 2 & 3*	
14.3.1	Describe the maintenance and testing requirements for temperature indicating systems including the following: a. Thermocouple handling b. Use of a Jetcal Analyser c. Use of a Barfield Tester d. Continuity Tests	2
14.3.2	Describe the construction, handling and installation requirements relating to thermocouple leads.	2
14.4	**Indicating/Instrument Systems** *Study Ref. 1, 2 & 3*	
14.4.1	From given information, identify the effects of faults in components on the engine instrument system.	2
14.4.2	Identify appropriate instruments and typical readings on these instruments that indicate an engine is suffering given common defects or performance abnormalities.	2

15	**Power Augmentation Systems**	
	ATA 82	
15.1	**Basic Requirements and Principles of Operation** *Study Ref. 1, 2 & 3*	
15.1.1	Outline the basic requirements, arrangements and principles of operation of the following gas turbine power augmentation systems and components: a. Water (demineralised) injection b. Water/methanol injection	2
15.1.2	Specify the effect that fluid injection has on performance and efficiency across the various stages of the engine.	2
15.1.3	Identify where on an engine water may be injected into the gas flow.	2
15.1.4	Specify how injected fluid actually increases power output of an engine. Identify the power increase a modern water injection system may achieve.	2
15.1.5	Describe the relationship, location and function of the engine power augmentation system components and the interrelationship between the augmentation system and the fuel control system.	2
15.2	**System Maintenance** *Study Ref. 1, 2 & 3*	
15.2.1	From given information, identify the effects of faults in components in power augmentation systems.	2

16	**Engine Controls**	
	ATA 76	
16.1	**Basic System Requirements and Operation** *Study Ref. 1, 2 & 3*	
16.1.1	Outline the basic requirements, arrangements and principles of operation of the following engine controls: a. Linkages and controls to and from the propeller co-ordinator/interconnector and fuel control unit b. Mechanical control inputs and outputs for electronic fuel control systems c. Throttle/power/condition lever cables and linkages d. Units and components interconnected for emergency shutdown e. Turbo-prop overspeed safety devices f. Integration of engine and propeller controls	1
16.2	**Control System Components** *Study Ref. 1, 2 & 3*	
16.2.1	Describe the relationship, location and function of mechanical control system units and components.	1
16.3	**Control System Maintenance** *Study Ref. 1, 2 & 3*	
16.3.1	From given information, determine the location and rectification requirements of engine mechanical control system faults.	1

17	Fire/Overheat Detection and Extinguishing Systems	
	ATA 26	
17.1	**Terms** *Study Ref. 1 & 2*	
17.1.1	Define the meaning of the following terms associated with engine fire protection: a. Fire detection b. Fire containment c. Fire extinguishing d. Engine overheat detection	1
17.2	**Types of System** *Study Ref. 1 & 2*	
17.2.1	Describe the following general classifications of fire detection systems: a. Spot-detection type b. Continuous-loop type	2
17.2.2	Describe the construction, layout and principles of operation of the following fire surveillance systems: a. Single-wire thermal switch b. Two-wire thermal switch c. Continuous loop (Kidde and Fenwal) d. Pneumatic loop e. Lindberg f. Systron-Donner g. Flame detector h. Smoke detector	1
17.2.3	Describe the purpose, construction and operation of the dual loop system.	2
17.3	**System Operation and Testing** *Study Ref. 1 & 2*	
17.3.1	Where applicable, describe how each system is tested for serviceability.	1
17.3.2	Describe how a reset function operates.	1
17.3.3	Specify how the Jetcal analyser may be used for testing the continuous loop fire detector.	2
17.3.4	Outline the general layout of a typical pod and pylon continuous loop fire detection system with particular regard to the following: a. Sensing wire locations b. Overheat control unit c. Extinguisher discharge tube outlets d. Diffuser orifice e. Agent container	1
17.3.5	Describe the construction and testing of a fire bottle.	1
17.4	**Fire Extinguishing Agents** *Study Ref. 1 & 2*	
17.4.1	Describe the advantages, disadvantages, conditions and precautions (as appropriate) of the following extinguishing agents used on gas turbine engines. State where each is likely to be used. a. Carbon dioxide b. Halogenated Hydrocarbons (Bromochlorodifluoromethane, Bromotrifloromethane)	2

17.5	**Fire Extinguishing Procedures** *Study Ref. 1 & 2*	
17.5.1	Describe the action to be taken by both the flight and ground crews when a fire occurs in the gas path of an engine during start-up. Have particular regard for the requirement to maintain starter motor operation.	2
17.5.2	Specify the requirements for engine cleaning after the use of extinguishing agents on an engine fire.	2

18	Engine Noise Suppression	
18.1	**Noise Sources**	
	Study Ref. 1 & 2	
18.1.1	Describe how noise is generated in a gas turbine engine and identify the areas around an engine where noise levels differ.	1
18.1.2	Identify the differences in noise level between the types of engine and distinguish why some engine types are noisier than others.	1
18.2	**Engine Noise Suppression**	
	Study Ref. 1 & 2	
18.2.1	Describe the purpose, constructional features and principle of operation of engine noise suppressors.	2
18.2.2	Outline the construction methods and features of noise absorbing material.	1
18.2.3	Describe acoustic energy conversion.	1
18.2.4	Explain the relationship of noise levels to the turbulence and energy in the exhaust gas stream, including typical noise patterns and methods of reducing noise level.	1
18.2.5	Describe typical locations of noise suppression materials used in gas turbine powerplant assemblies.	1
18.2.6	Specify the operation of a “hush-kit”.	1

19	**Engine Starting Systems**	
	ATA 80	
19.1	**Starter Types** *Study Ref. 1 & 2*	
19.1.1	Describe construction and operating principles of the types of starter found on gas turbine engines, including the following: a. Electric starters b. Starter/generators c. Pneumatic (air turbine) starters d. High-low pressure pneumatic starters e. Fuel-air combustion starters f. Turbine impingement starters g. Hydraulic starters h. Turbo systems (cartridge and mono fuel)	1
19.1.2	Describe the advantages of starter generators over conventional electric starters.	1
19.2	**Starter Operation** *Study Ref. 1 & 2*	
19.2.1	State where starters are normally mounted on the various types of gas turbine engine.	1
19.2.2	Specify how the engine rotating assemblies are powered using the above starting devices.	1
19.3	**Starter Components and Devices** *Study Ref. 1 & 2*	
19.3.1	Specify the function and construction of the starter pressure regulating and shut-off valve	1
19.3.2	Identify common starter system faults and appropriate rectification.	1
19.3.3	Describe the provision for manual assisted starting in the event of a start valve solenoid failure.	2
19.4	**Auxiliary/Ground Power Units** *Study Ref. 1 & 2*	
19.4.1	Describe the purpose and operation of an auxiliary/ground power unit used on modern aircraft including the following: a. General arrangements b. Intake and exhaust systems-door operation c. Load control d. Electrical output control and management e. Speed control f. Fuel control g. Safety features h. Ground/flight altitude limiting factors i. Mounting j. Fire protection and indication k. Bay cooling l. Ground running	1
19.4.2	Describe protection systems used on auxiliary/ground power units.	2

20	Engine Installation, Storage and Preservation	
20.1	**Engine Installation Components**	
	Study Ref. 1, 2 & 3	
20.1.1	Specify the function, construction and configuration of the following gas turbine powerplant components: a. Firewall b. Engine mounts c. Pylon d. Pod e. Cowlings f. Acoustic panels. g. Venting devices h. Engine zonal demarcations i. Anti vibration mounts j. Hoses k. Pipes l. Feeders m. Connectors n. Wiring looms o. Control cables and rods p. Lifting points q. Drains r. Blade containment areas/rings	1
20.2	**Maintenance Requirements**	
	Study Ref. 3	
20.2.1	Outline the general procedures for the replacement and ground testing of an engine.	1
20.2.2	State the use of engine stands, lifting devices and lifting points.	1
20.2.3	Describe the components and installation arrangements of a QEC facility.	1
20.3	**Storage, Preservation and Transportation**	
	Study Ref. 1, 2 & 3	
20.3.1	State the general requirements for the preservation and depreservation of gas turbine engines and accessories/systems both installed (on wing) and uninstalled.	1
20.3.2	State the requirements for transportation (road, rail, sea and air) of a turbine engine with particular regard to shock mounting, containerisation and other transportation devices.	1
20.3.3	Determine potential damage that could occur to an engine resulting from inadequate protection during transportation.	2

21	Engine Operation and Ground Running	
21.1	**General Ground Running Procedures** *Study Ref. 1, 2 & 3*	
21.1.1	Specify the general precautions and pre-start checks prior to ground running a gas turbine engine.	1
21.1.2	Describe general procedures for starting, ground run-up and stopping a gas turbine engine.	1
21.1.3	Define what is meant by self-sustaining rpm and how this is achieved.	1
21.1.4	Describe the cycle of engine operation as the power lever is advanced from ground idle to full power and back to ground idle.	2
21.2	**Defects and Malfunctions** *Study Ref. 1, 2 & 3*	
21.2.1	Determine engine and system malfunctions using given typical manufacturer's procedures and data.	2
21.2.2	Specify the indications, effects and remedial actions for the following defects: a. Hung start b. Hot start c. Wet start d. Poor acceleration up to sustainable rpm e. Over temp f. Compressor stall g. Compressor surge h. Lack of ignition i. Tail pipe fire j. Overspeed k. Over torque l. Bleed band or bleed valve stuck in the open or closed position	2
21.3	**Engine Performance Interpretation** *Study Ref. 1, 2 & 3*	
21.3.1	State the purpose of and describe the procedure of the following performance runs: a. engine trim b. power assurance. c. data-plate speed check d. torque check e. trim balance	2
21.3.2	State the source of ambient data used during an engine run.	1
21.3.3	Interpret engine power output and limitation charts and determine adjustment and rectification requirements.	2
21.4	**Operation of Anti-Ice Systems** *Study Ref. 1, 2 & 3*	
21.4.1	Describe the effects of anti-ice system operation on engine performance for the various types of gas turbine engine and how this would be shown in the cockpit.	2
21.5	**High Altitude Engine Operation** *Study Ref. 1, 2 & 3*	
21.5.1	Describe the effects of high altitude operation on turbo-prop and turbo-fan engines with multiple or split compressors.	2

22	Inspection and Maintenance	
	ATA 05	
22.1	**Cold-End Inspections** *Study Ref. 3*	
22.1.1	Using given data, determine permissible limits of damage and repair criteria on inlet guide vanes, compressor casings, stator blades, rotor blades and fan blades.	2
22.1.2	Identify lifed cold end components and determine their lives in terms of hours or cycles as appropriate.	2
22.1.3	Detail how internal clearances are checked.	3
22.1.4	Describe the adverse effects of oil leaks from bearing seals in the cold section and use manufacturer's data to describe how oil seals may be replaced in service.	2
22.1.5	Detail the special precautions to be taken when carrying out repairs to light alloy castings containing thorium.	2
22.2	**Hot-End Inspections** *Study Ref. 3*	
22.2.1	Using given data, determine limits for damage such as cracking, warpage, burning, erosion and hot spots in an engine combustion section.	2
22.2.2	Using given data, determine damage and repair limits for typical turbine blades/wheels, turbine case, turbine vanes and exhaust section.	2
22.3	**Internal Engine Inspection** *Study Ref. 3*	
22.3.1	Describe the use of specialised equipment designed for internal inspection of engines.	2
22.3.2	Specify the principles pertaining to engine condition and trend monitoring. Determine engine condition from given data.	2
22.3.3	Describe typical operational checks, tests, calibrations and adjustments associated with the in-service replacement of the following components: a. Fuel control unit b. Fuel control governor c. Torque-meter pump d. Ignition unit or igniters e. Combustor cans f. Burners g. Start fuel nozzles h. Hot end inspection i. Turbine blades or wheels j. Compressor blades k. Bleed bands or valves l. Reduction and accessory gearboxes including gears m. Thermo couples n. Indicating instruments o. Internal seals and bearings p. Starter generator q. Propeller r. Propeller governor s. Controls and actuators t. Power/pitch correlation devices on rotorcraft	2

22.3.4	Identify the atmospheric conditions in which engine calibration and trim checks should be undertaken.	2
22.3.5	Specify reasons for trimming an engine.	2

23	Turbo-Prop & Turbo-Shaft Engines	
	ATA 72	
23.1	**Turbo-prop Engines**	
	Study Ref. 1,2 & 3	
23.1.1	Describe the layout, operation and characteristics of the following turboprop engine configurations: a. Gas coupled/free turbine b. Gear coupled turbines.	2
23.1.2	Describe the layout and operation of reduction gears in turbo-prop engines.	2
23.1.3	Describe the operation of overspeed safety devices in turbo-prop engines.	2
23.2	**Turbo-shaft Engines**	
	Study Ref. 1,2 & 3	
23.2.1	Describe the layout, operation and characteristics of turbo-shaft engines.	2
23.2.2	Outline typical control systems in turbo-shaft engines.	2

24	Auxiliary Power Units (APUs)	
	ATA 49	
24.1	**APUs**	
	Study Ref. 1,2 & 3	
24.1.1	Describe the layout, operation and characteristics of APU, including protective systems.	2

25	**Turbine Engine Propellers**	
	ATA 61	
25.1	**Propeller Terminology** *Study Ref. 2 & 4*	
25.1.1	Define and explain the following terms relating to propellers: a. Leading edge b. Blade face c. Blade back d. Chord line e. Leading edge f. Trailing edge g. Plane of rotation h. Hub assembly i. Hub bore j. Blade Shank k. Blade l. Tip m. Blade curvature n. Blade cross section o. Blade stations p. Pitch distribution (twist)	1
25.2	**Propeller Theory** *Study Ref. 2 & 4*	
25.2.1	Define, giving practical explanations, the following terms relating to the operation of a propeller: a. Angle of attack b. Relative wind c. High/low blade angle and reverse angle d. Axis of rotation e. Forward velocity f. Propeller pitch g. Geometric pitch h. Effective pitch i. Slip j. Static RPM k. Rotational speed l. Design factor	2
25.2.2	Describe the effects of changes in the direction of the relative airflow on blade angle of attack.	2
25.3	**Operational Forces Acting on a Propeller** *Study Ref. 2 & 4*	
25.3.1	Specify the cause and effects of the following forces acting on a propeller: a. Centrifugal force b. Thrust bending force c. Torque bending force d. Aerodynamic twisting moment e. Centrifugal twisting moment f. Vibrational force and critical range	1

25.4	**Propeller Classifications** *Study Ref. 2 & 4*	
25.4.1	State the following classifications of propellers, giving advantages and disadvantages and examples where each may be used: a. Tractor propellers b. Pusher-type propellers c. Contra-rotating d. Controllable pitch e. Constant speed (automatic propellers) f. Reversible pitch g. Featherable	1
25.4.2	Describe the construction methods and specific materials used in composite and metal propellers.	1
25.5	**Inspection and Maintenance** *Study Ref. 2 & 4*	
25.5.1	Describe using diagrams how the following blade defects may be rectified, including the surface treatment processes involved: a. Pitting b. Nicks c. Dents d. Cracks e. Corrosion	2
25.5.2	Specify special treatments and repair schemes for metal and composite blades. Identify damage critical areas of a propeller blade.	2
25.5.3	Specify how the blade profile is maintained after leading edge repairs.	2
25.5.4	State how blade bend angle may be measured with a protractor.	1
25.5.5	Outline the general requirements for tracking a propeller including methods of adjustment.	1
25.6	**Mounting of Propellers** *Study Ref. 2 & 4*	
25.6.1	Describe typical mounting arrangements for turbo-prop propellers.	1
25.7	**Pitch Change Mechanisms** *Study Ref. 2 & 4*	
25.7.1	Describe the purpose and operation of the following pitch change mechanisms: a. Aerodynamic b. Aerodynamic and hydraulic combination c. Hydraulic d. Mechanical (counterweights) e. Electrical f. Pitch stops (fixed, centrifugal, manual, electrical and hydraulic low pitch)	1

25.8	**Propeller Auxiliary Systems** *Study Ref. 2 & 4*	
25.8.1	State the configuration and operation of the following typical auxiliary systems: a. Auto feather b. Feather (non auto) c. Ice protection/elimination d. Synchronising e. Synchrophasing f. Unfeathering accumulators g. Reversing systems h. Propeller brake systems i. Spinners j. Drive shaft safety couplings k. Braking control systems l. Starting requirements	1
25.9	**Ice Protection** *Study Ref. 1, 2 & 4*	
25.9.1	Describe the following types of propeller ice protection systems: a. Fluid. b. Electrical.	1
25.10	**Governors – Principles of Operation and Construction** *Study Ref. 2 & 4*	
25.10.1	Describe the operation of a typical governor fitted to turbo-prop aircraft.	2
25.11	**Governor/Propeller Operating Conditions** *Study Ref. 2 & 4*	
25.11.1	Describe the following operational conditions: a. Alpha b. Beta c. Feathering d. On speed e. Overspeed f. Underspeed g. Unfeathering h. Reverse pitch	2
25.12	**Propeller Maintenance Practices** *Study Ref. 2 & 4*	
25.12.1	Describe the construction, principles of operation and use of a propeller protractor.	1
25.12.2	Describe the procedure for replacement of a de-icer boot.	1
25.12.3	Outline typical removal and installation procedures for propellers including the use of the following: a. Torque multipliers b. Servicing stands c. Slings d. Lubricants e. Paddles	1
25.12.4	Describe the procedures for long and short-term storage of gas turbine propellers.	1