

Revision 3

10 March 2015

## Aircraft Maintenance Engineer Licence— Examination Subject 5 Aeroplanes 2

### 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** with the associated rule.

An acceptable means of compliance 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** to facilitate compliance with the rule requirements. Guidance material must not be regarded as an acceptable means of compliance.

This advisory circular is intended to be read with Part 66 Subpart B of the rule. If there are any conflicts between the advisory circular and the rule, the rule takes precedence.

### Purpose

This advisory circular provides an acceptable means of compliance for the syllabus content in respect of written examinations for Subject 5 (Aeroplane 2).

This advisory circular also provides guidance material 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’.

### Change Notice

Revision 3 makes the following changes:

- (a) updates the web address for Aviation Services Limited (ASL)
- (b) deletes reference to an AME sample question booklet being available for purchase from ASL
- (c) removes reference to examination length and number of questions.

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## Table of Contents

<b>Rule 66.53 Eligibility Requirements .....</b>	<b>5</b>
<b>Examination Overview: Subject 5 .....</b>	<b>6</b>
General Examining Objective .....	6
Knowledge Levels .....	6
<b>Recommended Study Material.....</b>	<b>7</b>
<b>Syllabus Layout .....</b>	<b>8</b>
<b>Syllabus: Subject 5 (Aeroplanes 2).....</b>	<b>9</b>
<b>1 Theory of Flight.....</b>	<b>9</b>
High Speed flight .....	9
Shock Waves .....	9
Speed of Sound .....	9
Sweepback.....	10
Control of High Speed Aircraft.....	10
Boundary Layer Control .....	10
Aerodynamic Balancing.....	10
Lift and Drag Devices on High Speed Aircraft .....	10
Low Speed Performance.....	11
<b>2 Structure of Jet and Turbo-prop Aircraft .....</b>	<b>12</b>
ATA-100 Identification System.....	12
Pressurised Structure Fundamentals – Fuselage .....	12
Fuselage Sealing .....	12
Fuselage Design Concepts, Equipment, Furnishings and Lights.....	13
Wings .....	13
Stabilisers .....	14
Nacelles and Pylons.....	14
Flight Control Surfaces.....	14
Doors .....	14
Glass Windows and Windscreens .....	14
<b>3 Control Systems .....</b>	<b>15</b>
Flight Controls.....	15
Flight Control System Components .....	15
Flutter .....	15
Automatic Flight Control Systems.....	15
Fly-By-Wire Systems.....	16
<b>4 Hydraulic Systems.....</b>	<b>17</b>
Hydraulic System Layout.....	17
Hydraulic Fluids .....	17
Hydraulic Filters .....	17
Pressurised Reservoirs .....	18
Hydraulic Pumps .....	18
Hydraulic System Flow Control Valves .....	18
Hydraulic System Pressure Control Devices .....	18
Actuating Cylinders and Hydraulic Motors .....	19
Hydraulic Seals.....	19
Hydraulic Indicating Systems .....	19
Emergency Hydraulic Systems .....	19
<b>5 Landing Gear.....</b>	<b>20</b>
Landing Gear System Configuration .....	20
Landing Gear System Components.....	20
Shock Struts .....	20
Landing Gear Rigging.....	21
Nose Wheel Steering Systems .....	21

Nose Wheel Shimmy Damping .....	21
Retraction Systems .....	21
Wheel Assemblies .....	22
Inspection of Wheel Assemblies .....	22
Tyre Assemblies .....	22
Maintenance of Tyres .....	23
Operating Characteristics of Tyres .....	23
Tyre Pressure Loss .....	24
Assessment of Tyre Condition and Defects .....	24
Brake Assemblies .....	24
Brake System Operation .....	25
Brake Defects .....	25
Monitoring of Brake Temperature .....	25
Anti-skid Brake Control System .....	25
<b>6 Pneumatic Systems .....</b>	<b>26</b>
Pneumatic System Layout .....	26
<b>7 Pressurisation Systems .....</b>	<b>27</b>
Terminology .....	27
Basic System Requirements .....	27
Pressurisation System Components .....	27
System Layout .....	27
Cabin Air Distribution .....	28
System Operation .....	28
Fault Finding and Maintenance .....	28
<b>8 Air-conditioning Systems .....</b>	<b>29</b>
General Functions .....	29
Air-Conditioning Principles and Terminology .....	29
Vapour Cycle System .....	29
Air-Cycle System Components .....	30
Basic Air-Cycle System Layout and Operation .....	30
Typical Aircraft Air-Cycle System Layout, Operation and Fault Finding .....	30
Temperature Control and Air Distribution .....	30
<b>9 Oxygen Systems .....</b>	<b>32</b>
General .....	32
Forms of Oxygen .....	32
Continuous Flow and Pressure Demand Systems .....	32
Chemical Oxygen Systems .....	33
Portable Oxygen Equipment .....	33
System Advantages .....	33
Oxygen System Servicing and Precautions .....	33
<b>10 Ice and Rain Protection Systems .....</b>	<b>34</b>
General .....	34
Ice Detecting Devices .....	34
Pneumatic De Ice System .....	34
Pneumatic De-Ice System Maintenance .....	34
Thermal Anti-Ice Systems .....	35
Chemical (Fluid) De-icing systems .....	35
Rain Control Systems .....	35
<b>11 Fuel Systems .....</b>	<b>36</b>
General .....	36
Fuel System Maintenance .....	36
Fuel Contents and Flow Measurement .....	36
<b>12 Fire Detection and Extinguishing Systems .....</b>	<b>38</b>
General .....	38
Fixed Fire Extinguishing Systems .....	38
Portable Fire Extinguishing Systems .....	38
Inspection and Maintenance .....	38
Extinguisher Agents .....	38
Smoke Detection .....	38
Master Central Warning Systems .....	39
<b>13 Reliability Fundamentals and Aircraft Structural Maintenance Concepts .....</b>	<b>40</b>

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<b>Terminology</b> .....	40
<b>Failure</b> .....	40
<b>Maintenance Programmes</b> .....	40
<b>Quality Fundamentals</b> .....	41
<b>Service Data</b> .....	41

## **Rule 66.53 Eligibility Requirements**

Rule 66.53(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 5 (Aeroplanes 2) 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 5

The pass mark for Subject 5 (Aeroplanes 2) is 70%.

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

### General Examining Objective

The objective of the examination is to determine that the applicant for an AMEL has adequate knowledge of Subject 5 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	Mechanics of Flight	AC Kermode	978-1-4058-2359-3
2	A & P Technician Airframe Textbook	Jeppesen	0-88487-331-5
3	Aviation Maintenance Technicians Series, Airframe - Volumes 1 Structures & 2 Systems	Dale Crane	1-56027-339-9 1-56027-340-2
4	Transport Category Aircraft Systems	Jeppesen	0-88487-232-7
5	FAA AC43.13-B: Acceptable Methods, Techniques and Practices Aircraft Inspection and Repair. See: <a href="#">FAA website</a>	FAA	0-89100-306-1
6	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 5 (Aeroplanes 2)

<b>1</b>	<b>Theory of Flight</b>	
<b>1.1</b>	<b>High Speed flight</b> <i>Study Ref. 1</i>	
1.1.1	Describe the following criteria and state what factors affect each: <ul style="list-style-type: none"> <li>a. Mach number</li> <li>b. Approximate mach number which differentiates subsonic, transonic and supersonic flight</li> <li>c. Critical Mach number</li> <li>d. Mach cone</li> <li>e. Subsonic flight</li> <li>f. Supersonic flight</li> <li>g. Transonic flight</li> <li>h. Supersonic airflow characteristics</li> <li>i. The effects of atmospheric characteristics on the speed of sound</li> <li>j. Aerodynamic/kinetic heating</li> <li>k. Area rule</li> <li>l. Compressibility and compressibility buffet</li> <li>m. Incompressibility</li> <li>n. Expansion waves</li> <li>o. Shock induced drag</li> <li>p. Shock induced stall</li> <li>q. Wake turbulence</li> <li>r. Airflows associated with the boundary layer</li> <li>s. Pressure disturbance propagation and the effect on supersonic airflow</li> <li>t. Approximate speed of a pressure disturbance</li> <li>u. Boundary layer and how it affects the aerodynamic performance of an aircraft</li> <li>v. Point of maximum camber of an aerofoil with respect to percentage of chord</li> <li>w. Supersonic flow through a divergent duct</li> </ul>	1
<b>1.2</b>	<b>Shock Waves</b> <i>Study Ref. 1</i>	
1.2.1	Describe the following factors relating to high-speed aerofoils and shock waves: <ul style="list-style-type: none"> <li>a. Subsonic and supersonic aerofoil shapes</li> <li>b. Supersonic free-stream</li> <li>c. Separation</li> <li>d. The speed at which shock waves start to form on the surface</li> <li>e. Changes of airflow characteristics when passing through a shock wave</li> <li>f. Bow wave</li> <li>g. Incipient shock waves and the mach number they may occur at</li> <li>h. Airflow characteristics over a high speed aerofoil as mach number increases</li> <li>i. Oblique shock wave</li> <li>j. Normal shock wave</li> <li>k. Expansion wave</li> <li>l. Creation of a normal shock wave on a sub-sonic aerofoil</li> <li>m. Creation of an expansion wave in a supersonic air flow</li> <li>n. The creation of shock waves as mach number increases</li> </ul>	1
<b>1.3</b>	<b>Speed of Sound</b> <i>Study Ref. 1</i>	
1.3.1	Describe the importance of the speed of sound in relation to modern aircraft design, performance and operation.	1

1.3.2	Specify the conditions and characteristics associated with aircraft operation at or near the sound barrier.	1
1.3.3	Describe the speed of sound in relation to ICAO standard atmosphere.	2
1.3.4	Identify the speed of airflow over aircraft components when the aeroplane is flying in the transonic range.	1
<b>1.4</b>	<b>Sweepback</b> <i>Study Ref. 1</i>	
1.4.1	Describe how sweepback affects the following: a. Thickness/chord ratio of the wing b. Drag c. Lift d. High speed stability e. Low speed stability	1
1.4.2	Describe the effects of sweepback and fineness ratio on critical mach number.	1
<b>1.5</b>	<b>Control of High Speed Aircraft</b> <i>Study Ref. 1</i>	
1.5.1	Describe control problems encountered in transonic and supersonic flight and state the methods used to overcome these problems.	2
1.5.2	Define the following terms as they relate to high-speed aircraft and explain how each occurs and methods used to control each of them: a. Dutch roll b. Pitch-up c. Mach tuck	3
1.5.3	Specify control reversal and state how it is prevented at high speed through the use of inboard ailerons and spoilers.	2
<b>1.6</b>	<b>Boundary Layer Control</b> <i>Study Ref. 1</i>	
1.6.1	Specify how boundary layer control is achieved using: a. wing fences b. saw tooth leading edges c. vortex generators d. stall wedges (leading edge spoilers) e. engine bleed air augmentation.	2
<b>1.7</b>	<b>Aerodynamic Balancing</b> <i>Study Ref. 1, 2 &amp; 3</i>	
1.7.1	Define aerodynamic balancing and the use of aerodynamic balance panels.	2
<b>1.8</b>	<b>Lift and Drag Devices on High Speed Aircraft</b> <i>Study Refs. 1, 2 &amp; 3</i>	
1.8.1	Describe the operation and effect of the following drag inducing devices: a. Spoilers b. Lift dumpers c. Speed brakes	2

1.8.2	Describe the operation and effect of the following high lift devices: <ul style="list-style-type: none"> <li>a. Slots</li> <li>b. Slats</li> <li>c. Flaps</li> <li>d. Leading edge flaps and slats</li> <li>e. Droop leading edges</li> </ul>	2
1.8.3	Specify what is meant by asymmetrical flap and slat operation, and state the adverse effects this may have on aircraft controllability.	2
1.8.4	Describe the operation and effects of the following devices as found on large transport aircraft: <ul style="list-style-type: none"> <li>a. Stall strips</li> <li>b. Vortex generators</li> <li>c. Modified wing tips including the use of tip tanks</li> <li>d. Winglets</li> <li>e. Canards</li> <li>f. T-Tails</li> <li>g. Spring tabs</li> <li>h. Trim tabs</li> <li>i. Servo tabs</li> <li>j. Balance tabs</li> <li>k. Anti-balance tabs</li> <li>l. Ground spoilers and flight spoilers</li> <li>m. Speed brakes</li> <li>n. Inboard and outboard flaps</li> <li>o. High and low speed ailerons</li> <li>p. Upper and lower rudders</li> <li>q. Yaw dampers</li> <li>r. Artificial feel</li> <li>s. Mach trim</li> <li>t. Gust locks</li> </ul>	2
<b>1.9</b>	<b>Low Speed Performance</b> <i>Study Refs. 1, 2 &amp; 3</i>	
1.9.1	State the factors affecting low speed performance of high-speed aircraft and describe how devices are used to overcome inherent poor performance characteristics.	1

<b>2 Structure of Jet and Turbo-prop Aircraft</b>		
<b>ATA 53, 53, 54, 55, 56, 57</b>		
<b>2.1</b>	<b>ATA-100 Identification System</b> <i>Study Ref. 4</i>	
2.1.1	Describe the ATA-100 zoning system used to identify component location and access points.	2
2.1.2	State how components are located according to the stations of an aircraft.	2
<b>2.2</b>	<b>Pressurised Structure Fundamentals – Fuselage</b> <i>Study Refs. 2 &amp; 3</i>	
2.2.1	Specify current practice in aircraft design related to: load transfer load path continuity reduction of stress raisers in pressurised fuselages.	1
2.2.2	Describe the nature of forces and the types of loads or stresses in a pressurised aircraft structure with particular regard to the following: a. Tension stress b. Hoop stress c. Shear forces d. Torsional forces e. Compressive forces f. Fatigue stress g. Crack propagation h. Bursting	2
2.2.3	State specific factors to be considered when inspecting pressurised structure.	2
2.2.4	Specify methods used to ensure that doors and other large cut-outs are restrained from opening under pressurisation loads.	2
2.2.5	Identify the various methods used to ensure protection from rapid decompression.	2
<b>2.3</b>	<b>Fuselage Sealing</b> <i>Study Refs. 2 &amp; 3</i>	
2.3.1	Describe methods used to seal the structure, and components to the structure of airframe pressure cells including the sealing of structure after a repair.	2
2.3.2	Describe sealing methods at pressure bulkheads for control and electrical cables.	2
2.3.3	Describe the sealing methods used for doors and cut-outs in pressure cells.	2
2.3.4	Specify the precautions associated with the maintenance of blowout panels, airflow louvers and decompression doors.	2
2.3.5	Specify typical leak testing procedures, precautions and limits, including test equipment, rigs, detecting materials, and the numbers and positioning of personnel.	2
2.3.6	Describe seals, sealants and sealant application techniques used in pressure cells.	2

<p><b>2.4</b></p> <p>2.4.1</p> <p>2.4.2</p> <p>2.4.3</p>	<p><b>Fuselage Design Concepts, Equipment, Furnishings and Lights</b></p> <p><i>Study Refs. 2 &amp; 3</i></p> <p>Specify the methods used to achieve minimum drag, aerodynamically clean structures.</p> <p>Describe the following fuselage features. Wing, stabiliser, pylon and undercarriage attachments Seat installation and cargo loading system</p> <p>Describe the following criteria relating to emergency equipment and furnishings:</p> <ul style="list-style-type: none"> <li>a. Emergency equipment requirements; seats, harnesses, belts, crash, rescue and first aid</li> <li>b. Cabin layout</li> <li>c. Operation of safety devices and control of service power supply</li> <li>d. Cabin furnishing installation, sound proofing, role change equipment</li> <li>e. Cabin entertainment equipment including films, video, television, audio and public address systems</li> <li>f. Galley installation, catering trolleys, refrigeration units, heaters and lift mechanisms</li> <li>g. Water system layout, supply distribution, pressure control, servicing and draining</li> <li>h. Toilet and sanitary systems layout, flushing, servicing and health precautions</li> <li>i. Corrosion prevention in toilet/galley areas</li> <li>j. Cargo handling, freight stowage and retention equipment</li> <li>k. Air stairs</li> <li>l. Waste collection and drainage</li> <li>m. Safety precautions relating to emergency exits and slides</li> <li>n. Operation of emergency equipment</li> <li>o. Operation of internal and external, normal and emergency lighting systems</li> </ul>	<p>1</p> <p>1</p> <p>1</p>
<p><b>2.5</b></p> <p>2.5.1</p>	<p><b>Wings</b></p> <p><i>Study Refs. 2 &amp; 3</i></p> <p>Describe the following features relating to a wing section:</p> <ul style="list-style-type: none"> <li>a. Structural components in a modern wing</li> <li>b. Stressed skin design</li> <li>c. Wing/fuselage attachment</li> <li>d. Wing inner, outer and centre section assemblies</li> <li>e. Multi-spar metal wing structure</li> <li>f. Milled wing skins and spars</li> <li>g. Chemically milled wing skins</li> <li>h. Integral milling</li> <li>i. Contour etching</li> <li>j. Integral fuel tank construction</li> <li>k. Warren girder construction</li> <li>l. Box-beam milled wing</li> <li>m. Honeycomb sandwich leading edge construction</li> <li>n. Landing gear attachment</li> <li>o. Pylon attachment</li> <li>p. Control surface attachment</li> <li>q. High lift/drag device attachments</li> <li>r. Tracks for slats and flaps</li> <li>s. Manufacturing processes, techniques and fasteners</li> <li>t. Bonding of structural components</li> <li>u. Strengthening techniques and devices including doublers</li> <li>v. Wing fairings, access panels and track cans</li> <li>w. Aerodynamic seals</li> </ul>	<p>1</p>

<b>2.6</b>	<b>Stabilisers</b> <i>Study Refs. 2 &amp; 3</i>	
2.6.1	Describe the construction and attachment of stabiliser assemblies.	1
2.6.2	Specify the methods of control surface attachment to stabilisers.	2
<b>2.7</b>	<b>Nacelles and Pylons</b> <i>Study Refs. 2 &amp; 3</i>	
2.7.1	Describe the construction of firewalls, engine mounts and engine pylon assemblies.	1
<b>2.8</b>	<b>Flight Control Surfaces</b> <i>Study Refs. 2 &amp; 3</i>	
2.8.1	Describe the construction and attachment of flight control surfaces.	2
2.8.2	Explain the mass and aerodynamic balance processes, including calculations, for flight control surfaces of modern jet and turbo-prop aircraft.	3
<b>2.9</b>	<b>Doors</b> <i>Study Refs. 2 &amp; 3</i>	
2.9.1	Describe the construction and operation of a typical door and escape hatch fitted to a pressurised aircraft with particular regard to the following: <ul style="list-style-type: none"> <li>a. Sealing and seal inflation</li> <li>b. Operating mechanisms</li> <li>c. Safety precautions</li> <li>d. Common faults and defects</li> </ul>	1
<b>2.10</b>	<b>Glass Windows and Windscreens</b> <i>Study Refs. 2 &amp; 3</i>	
2.10.1	Describe the following criteria in respect of glass windshields: <ul style="list-style-type: none"> <li>a. Construction</li> <li>b. Lamination</li> <li>c. Fitting</li> <li>d. Removal</li> <li>e. Handling</li> <li>f. Storage</li> <li>g. Inspection</li> <li>h. Heating</li> <li>i. Sealing</li> <li>j. Cleaning</li> <li>k. Minor damage and repair techniques for cracks and delamination.</li> </ul>	1

<b>3 Control Systems</b>		
<b>ATA 27</b>		
<b>3.1</b>	<b>Flight Controls</b> <i>Study Refs. 2, 3 &amp; 4</i>	
3.1.1	Explain primary and secondary control surfaces on modern jet and turbo-prop air transport aircraft including the following characteristics: <ul style="list-style-type: none"> <li>a. Method of attachment</li> <li>b. Method of construction</li> <li>c. Principles of operation</li> <li>d. Effects on flight performance</li> </ul>	3
<b>3.2</b>	<b>Flight Control System Components</b> <i>Study Refs. 2, 3 &amp; 4</i>	
3.2.1	Explain in detail the purpose and operating principles of the following control system components fitted to modern jet and turbo-prop aircraft: <ul style="list-style-type: none"> <li>a. Cable tension regulator</li> <li>b. Aileron torque limiters</li> <li>c. Surface position indicators</li> <li>d. Flight control panels</li> <li>e. Yaw dampers</li> <li>f. Spoiler mixers</li> <li>g. Control feel systems</li> <li>h. Flight control surface dampers</li> <li>i. Potentiometers</li> <li>j. Power drive units for flaps and slats</li> <li>k. Asymmetry control devices</li> <li>l. Hydraulic motors and gear boxes</li> <li>m. Power boosted and power operated systems</li> <li>n. Torque tubes</li> <li>o. Servo jacks</li> <li>p. Stick shakers and pushers</li> <li>q. Manual reversion systems</li> <li>r. Irreversible control systems</li> </ul>	2
<b>3.3</b>	<b>Flutter</b> <i>Study Refs. 2, 3 &amp; 4</i>	
3.3.1	Specify the cause and effects of flutter in the control surfaces of high-speed aircraft.	2
3.3.2	Identify the control surfaces most prone to flutter.	2
3.3.3	Explain the procedure for static mass balancing of flight control surfaces with particular regard to the following factors: <ul style="list-style-type: none"> <li>a. The meaning of under balance, overbalance and neutral balance</li> <li>b. Desirable state of balance</li> <li>c. Balance limits</li> <li>d. Location and attachment of mass balance weights</li> <li>e. Calculation of changes to balance weight</li> <li>f. Balancing equipment</li> <li>g. Desirable environmental conditions</li> <li>h. Final flight configuration of the control surface</li> </ul>	3
<b>3.4</b>	<b>Automatic Flight Control Systems</b> <i>Study Refs. 2, 3 &amp; 4</i>	

3.4.1	<p>Describe the following features relating to an autopilot system fitted to a modern jet or turbo-prop aircraft:</p> <ol style="list-style-type: none"> <li>a. Basic system layout and control surface interface of a three axis autopilot</li> <li>b. Inputs during flight</li> <li>c. Identification and the effects of signals</li> <li>d. Purpose, location and operating principle of sensing units</li> <li>e. Purpose of the position transmitter</li> <li>f. Purpose and operation of servomotors, controller, gyro and computer</li> <li>g. Function and operation of channels in relation to pitch and roll</li> <li>h. Control system interfaces</li> <li>i. Ground functional checks and anticipated control surface responses</li> <li>j. Functions of a flight controller in respect of manual manoeuvrability of the aircraft</li> </ol>	1
3.4.2	Identify the likely cause of defects relating to autopilot operation and how these defects may be confirmed and rectified.	2
3.5	<p><b>Fly-By-Wire Systems</b></p> <p><i>Study Ref. 4</i></p>	
3.5.1	<p>Describe a typical fly-by-wire control system with particular emphasis on the following:</p> <ol style="list-style-type: none"> <li>a. Digital and analogue systems</li> <li>b. Computerisation</li> <li>c. Auto pilot commands</li> <li>d. Auto trim</li> <li>e. Motor actuators/power control units</li> <li>f. Feedback</li> <li>g. Travel limitation</li> <li>h. Landing gear control interface</li> <li>i. Side stick controller</li> <li>j. Load alleviation</li> <li>k. Hydraulic/electrical interfaces</li> <li>l. Backup and redundancy</li> <li>m. Gust suppression</li> <li>n. Self test</li> </ol>	1



<b>4 Hydraulic Systems</b>		
<b>ATA</b>		
<b>4.1</b>	<b>Hydraulic System Layout</b> <i>Study Refs. 2, 3 &amp; 4</i>	
4.1.1	Detail the layout of a typical, modern jet and turbo-prop aircraft hydraulic system with particular regard to the following factors. (eg 747-400 or 737-3/4/5) <ul style="list-style-type: none"> <li>a. The integration of multiple hydraulic systems</li> <li>b. Means of power and backup power for each system</li> <li>c. Functions of each system</li> <li>d. Special operating characteristics and features of each system</li> <li>e. Typical locations for quick disconnect fittings</li> <li>f. Location and installation of an accumulator in a hydraulic system</li> <li>g. Interfaces with electrical and emergency systems</li> </ul>	3
<b>4.2</b>	<b>Hydraulic Fluids</b> <i>Study Refs. 2, 3 &amp; 4</i>	
4.2.1	Explain the following factors relating to phosphate ester based hydraulic fluids such as Skydrol 500B and Skydrol LD: <ul style="list-style-type: none"> <li>a. Identification</li> <li>b. Flammability</li> <li>c. Chemical stability</li> <li>d. Intermixing with other fluid types</li> <li>e. Identification of fluid contamination using a colour comparison test</li> <li>f. System decontamination where inadvertent mixing has occurred</li> <li>g. Toxicity</li> <li>h. Handling precautions</li> <li>i. Corrosiveness</li> <li>j. Affect on painted surfaces and cleaning up hydraulic fluid spills</li> <li>k. Seal compatibility</li> <li>l. Colour code identification of hydraulic system lines and pipes</li> </ul>	3
4.2.2	Specify the fluid used to flush a Skydrol system.	2
4.2.3	Describe the various types, physical characteristics and standard identification designator of aviation hydraulic fluids and where each type of fluid is likely to be found.	2
4.2.4	Identify the flammability characteristics of hydraulic fluids other than Skydrol.	1
4.2.5	Specify the essential properties of hydraulic fluid used in aircraft systems.	2
<b>4.3</b>	<b>Hydraulic Filters</b> <i>Study Refs. 2, 3 &amp; 4</i>	
4.3.1	Describe the following characteristics pertaining to a micron type filter using a paper element: <ul style="list-style-type: none"> <li>a. Construction</li> <li>b. Filtering operation</li> <li>c. Servicing</li> <li>d. Clogging alert systems</li> </ul>	2
4.3.2	Describe the construction and operation of a hydraulic filter using a metal filter element.	2
4.3.3	Describe the construction and operation of a two-stage hydraulic filter.	2
4.3.4	Describe the construction and operation of a Cuno type hydraulic filter.	2

<b>4.4</b>	<b>Pressurised Reservoirs</b> <i>Study Refs. 2, 3 &amp; 4</i>	
4.4.1	State the following factors relating to pressurised hydraulic reservoirs: <ul style="list-style-type: none"> <li>a. The three main ways of reservoir pressurisation and the principles of operation</li> <li>b. The components associated with each type of reservoir</li> <li>c. Why pressurisation of reservoirs is necessary</li> <li>d. How pressure is controlled</li> </ul>	2
<b>4.5</b>	<b>Hydraulic Pumps</b> <i>Study Refs. 2, 3 &amp; 4</i>	
4.5.1	Specify the purpose, uses and principles of operation of the following types of hydraulic pump: <ul style="list-style-type: none"> <li>a. Gear type pumps</li> <li>b. Gerotor type pumps</li> <li>c. Double acting hand pumps</li> <li>d. Variable displacement axial-piston types</li> <li>e. Ram air turbine/hydraulic pumps</li> <li>f. Bleed air driven pumps</li> </ul>	2
4.5.2	Specify the effects of air entering a hydraulic pump during normal operation.	2
<b>4.6</b>	<b>Hydraulic System Flow Control Valves</b> <i>Study Refs. 2, 3 &amp; 4</i>	
4.6.1	Describe the construction, operation, location and functions of the following hydraulic system flow control valves: <ul style="list-style-type: none"> <li>a. Open and closed centre selector valves</li> <li>b. Ball, cone, swing and orifice type in-line check valves including identification of their correct flow direction</li> <li>c. Sequence valves</li> <li>d. Selector valves including the four-way closed centre, spool-type and rotary valves</li> <li>e. Priority valves</li> <li>f. Quick or line disconnect valves</li> <li>g. Hydraulic fuses</li> </ul>	2
<b>4.7</b>	<b>Hydraulic System Pressure Control Devices</b> <i>Study Refs. 2, 3 &amp; 4</i>	
4.7.1	Describe the construction, operation, location and functions of the following hydraulic system pressure control valves: <ul style="list-style-type: none"> <li>a. Relief valves (four and two port)</li> <li>b. Pressure regulators including spool type regulators</li> <li>c. Pressure reducers</li> <li>d. Accumulators (diaphragm, bladder and piston type)</li> <li>e. Thermal relief valves</li> <li>f. De-boosters</li> <li>g. Cut-off valves</li> <li>h. Low demand fluid circulation devices</li> <li>i. System protection from overpressure damage</li> </ul>	2
4.7.2	Describe the pressure adjustment sequence for multiple pressure regulating valves in a hydraulic system.	2
4.7.3	State how a hydraulic accumulator is installed and charged.	2

4.7.4	Identify hydraulic pressures in a system relevant to the accumulator charge pressure.	2
4.7.5	Specify the cause of “hammering in a hydraulic system.	2
<b>4.8</b>	<b>Actuating Cylinders and Hydraulic Motors</b> <i>Study Refs. 2, 3 &amp; 4</i>	
4.8.1	Describe the construction, operation and uses of the following actuating devices: <ul style="list-style-type: none"> <li>a. Single-action actuating cylinder</li> <li>b. Double-action actuating cylinder</li> <li>c. Ported piston actuating cylinder</li> <li>d. Cushion-type linear actuator</li> <li>e. Rack-and-pinion type linear actuators</li> <li>f. Piston-type rotary hydraulic motor</li> <li>g. Balanced vane-type hydraulic motor</li> </ul>	2
4.8.2	State the purpose and operation of a flap overload valve in a hydraulic flap operating system.	2
<b>4.9</b>	<b>Hydraulic Seals</b> <i>Study Refs. 2, 3 &amp; 4</i>	
4.9.1	Describe the construction, sealing operation, uses, installation, removal and tooling associated with the following hydraulic seals and seal components: <ul style="list-style-type: none"> <li>a. One-way seals including, chevron, V-ring, U-ring, D-ring packings</li> <li>b. Two-way seals</li> <li>c. O-rings</li> <li>d. Back-up rings (Teflon)</li> <li>e. Seal materials</li> <li>f. Seal compatibility</li> <li>g. Wipers</li> </ul>	2
4.9.2	State the purpose of using back-up rings with “O” rings in high-pressure hydraulic systems.	2
<b>4.10</b>	<b>Hydraulic Indicating Systems</b> <i>Study Ref. 2, 3 &amp; 4</i>	
4.10.1	Explain typical hydraulic pressure, contents and temperature indicating systems and their respective components.	3
<b>4.11</b>	<b>Emergency Hydraulic Systems</b> <i>Study Refs. 2, 3 &amp; 4</i>	
4.11.1	Describe the principles of operation and components associated with emergency hydraulic systems fitted to modern jet and turbo-prop air transport aircraft.	2
4.11.2	Describe the cause of kickback in an emergency hand pump handle.	2
4.11.3	Specify how and where fluid is stored in the hydraulic system for auxiliary or emergency pump operation.	2

<b>5 Landing Gear</b>		
<b>ATA 32</b>		
<b>5.1</b>	<b>Landing Gear System Configuration</b> <i>Study Refs. 2 &amp; 3</i>	
5.1.1	Describe the following landing gear configurations for modern jet and turbo-prop air transport aircraft: a. Dual main landing gear wheel arrangement b. "Bogie" truck main landing gear configuration	2
<b>5.2</b>	<b>Landing Gear System Components</b> <i>Study Refs. 2 &amp; 3</i>	
5.2.1	Explain the function of the following components as appropriate to the above main landing gear assemblies: a. Pivot trunnion and trunnion beam b. Drag brace or strut c. Upper and lower side braces d. Upper and lower shock strut cylinders e. Torque link arms f. Positioner g. Equaliser h. Pivot beam, pivot fork and shafts i. Up and down-lock methods j. Down-lock bungee	3
<b>5.3</b>	<b>Shock Struts</b> <i>Study Refs. 2 &amp; 3</i>	
5.3.1	Describe the construction and principles of operation of the following main landing gear shock struts: a. Metering pin type b. Metering tube type c. Separator piston type	2
5.3.2	Specify the purpose, construction and operation of the following components. a. Damping and snubbing devices b. Mounting assemblies c. Glands and packings d. Seals and backing rings e. Axles	2
5.3.3	Identify the fluids used in modern shock struts for load absorption or cushioning.	2
5.3.4	Describe the construction and operation of air charging valves fitted to shock strut assemblies.	2
5.3.5	Detail a typical shock strut charging and bleeding procedures for separator and non-separator type struts.	3
5.3.6	Explain how the correct shock strut fluid level would be established.	3

5.3.7	Describe the construction, location and operation of the following landing gear safety devices: <ul style="list-style-type: none"> <li>a. Safety switch (Squat Switch)</li> <li>b. Cockpit located anti retraction devices</li> <li>c. Ground locks</li> <li>d. Gear indicators</li> </ul>	2
<b>5.4</b>	<b>Landing Gear Rigging</b> <i>Study Refs. 2 &amp; 3</i>	
5.4.1	Specify the following rigging and adjustment procedures on common types of landing gear: <ul style="list-style-type: none"> <li>a. Gear latching</li> <li>b. Gear door clearance</li> <li>c. Drag and side brace adjustment</li> <li>d. Landing gear retraction</li> </ul>	2
5.4.2	Describe a typical landing gear retraction check for a large transport aircraft.	2
5.4.3	Specify the function, operation and adjustment of the landing gear warning horn and give likely reasons for horn malfunction.	2
<b>5.5</b>	<b>Nose Wheel Steering Systems</b> <i>Study Refs. 2 &amp; 3</i>	
5.5.1	Detail the operation of a modern nose wheel steering system including the following features: <ul style="list-style-type: none"> <li>a. Cockpit control</li> <li>b. Mechanical, electrical or hydraulic linkages</li> <li>c. Metering or control valve in the control unit</li> <li>d. Power sources</li> <li>e. Steering cylinders</li> <li>f. Compensator/accumulator unit</li> <li>g. Pressurising assembly</li> <li>h. Follow up mechanism</li> <li>i. Safety valves</li> <li>j. Centring cam</li> <li>k. Differential assembly</li> </ul>	3
<b>5.6</b>	<b>Nose Wheel Shimmy Damping</b> <i>Study Refs. 2 &amp; 3</i>	
5.6.1	Describe the construction and operation of the following types of shimmy damper: <ul style="list-style-type: none"> <li>a. Piston type</li> <li>b. Vane type</li> <li>c. Steer damper</li> </ul>	2
5.6.2	Identify the causes of nose wheel shimmy on large transport aircraft.	2
<b>5.7</b>	<b>Retraction Systems</b> <i>Study Refs. 2 &amp; 3</i>	
5.7.1	Describe the construction and principles of operation of the following systems: <ul style="list-style-type: none"> <li>a. Electrical landing gear retraction systems</li> <li>b. Hydraulic landing gear retraction systems</li> <li>c. Emergency extension systems including hand operated pumps</li> </ul>	2
5.7.2	Identify common undercarriage retraction faults, their likely cause and means of indication in the cockpit.	2

<b>5.8</b>	<b>Wheel Assemblies</b> <i>Study Refs. 2 &amp; 3</i>	
5.8.1	Specify the materials, construction and components, which make up the following types of modern wheel assemblies: a. Split wheel b. Removable flange wheels c. Fixed flange, drop centre	2
5.8.2	Describe the types of wheel bearing that may be found in jet transport aircraft wheel assemblies.	2
5.8.3	Describe how air leakage is prevented on split wheel assemblies using tubeless tyres.	2
<b>5.9</b>	<b>Inspection of Wheel Assemblies</b> <i>Study Ref. 2 &amp; 3</i>	
5.9.1	Describe the following wheel inspections and specify typical defects that may be found: a. NDT inspection of the castings b. Wheel bolt inspection c. Key and key screw inspection d. Fusible plug inspection e. Balance weights f. Corrosion inspection	2
<b>5.10</b>	<b>Tyre Assemblies</b> <i>Study Refs. 2 &amp; 3</i>	
5.10.1	Define the following terms relating to modern aircraft tyre construction: a. Tyre classification in terms of type, ply rating, tube or tubeless b. Bead, bead toe, bead heel c. Carcass d. Tread including, plain, all weather, rib and chine e. Breakers f. Casing plies/cord body g. Flippers h. Chafers i. Inner liner j. Tread reinforcing ply, under tread k. Sidewall l. Apex strip m. Tube construction and selection	2
5.10.2	Specify the conditions and international rules relating to the use of radial ply tyres on aircraft.	1

<p><b>5.11</b></p> <p>5.11.1</p>	<p><b>Maintenance of Tyres</b></p> <p><i>Study Refs. 2 &amp; 3</i></p> <p>Describe the following factors relating to the maintenance of aircraft tyres:</p> <ul style="list-style-type: none"> <li>a. Proper inflation for satisfactory service</li> <li>b. The effects of under inflation and over inflation</li> <li>c. Sources of tyre pressure data</li> <li>d. The effects of heat on tyre performance and life</li> <li>e. Actions to be taken if the fusible plug in the wheel melts</li> <li>f. Tread condition including tread depth and wear pattern</li> <li>g. Tread damage</li> <li>h. Bead inspection and damage</li> <li>i. Sidewall condition and damage</li> <li>j. Bulges and broken cords</li> <li>k. Liner blistering</li> <li>l. Thermal fuse inspection</li> <li>m. Allowance for nylon stretch</li> <li>n. Tubeless air diffusion loss</li> <li>o. Lubrication of tubeless tyres during mounting</li> <li>p. Pressure equalisation in dual tyres</li> <li>q. Overloading limitations and defects</li> <li>r. Nylon flat spotting</li> <li>s. Tyre repair and repairable injuries including spot repairs</li> <li>t. Tyre storage including avoidance of moisture and ozone</li> <li>u. Fuel and solvent hazards</li> <li>v. Tube storage</li> <li>w. Tyre inspection and probing of injuries</li> <li>x. Tyre mounting of tube type and tubeless tyres including inflation/deflation/re-inflation requirements</li> <li>y. Tyre balancing</li> <li>z. Tyre inflation safety precautions</li> <li>aa. Venting of tubeless tyres</li> <li>bb. Initial stretch period</li> <li>cc. Demounting safety</li> <li>dd. Leaks or valve damage</li> <li>ee. Chevron cuts in the tyre centre resulting from the runway surface</li> <li>ff. Retreading requirements and conditions including, top capping, full capping, three-quarter retreads and bead to bead retreads</li> <li>gg. Uneven wear</li> <li>hh. Wheel damage</li> <li>ii. Tube inspection including valve stems, wrinkles, chafing, thinning</li> <li>jj. Use of a tyre pressure gauge</li> <li>kk. Cleaning types after spills of fuel, oil or hydraulic fluid</li> <li>ll. Balance and slippage marks</li> <li>mm. Gasses commonly used for tyre inflation</li> </ul>	<p>2</p>
<p><b>5.12</b></p> <p>5.12.1</p>	<p><b>Operating Characteristics of Tyres</b></p> <p><i>Study Ref. 2 &amp; 3</i></p> <p>Describe tyre characteristics under the following aircraft operating conditions:</p> <ul style="list-style-type: none"> <li>a. Taxiing</li> <li>b. Braking and pivoting</li> <li>c. Takeoff and landing</li> <li>d. Hydroplaning</li> </ul>	<p>2</p>

<p><b>5.13</b></p> <p>5.13.1</p>	<p><b>Tyre Pressure Loss</b></p> <p><i>Study Ref. 2 &amp; 3</i></p> <p>Describe the causes of air pressure loss in tubeless aircraft tyres under the following conditions:</p> <ul style="list-style-type: none"> <li>a. Damaged beads</li> <li>b. Improperly seated beads</li> <li>c. Cut or puncture</li> <li>d. Air temperature</li> <li>e. Venting</li> </ul>	<p>2</p>
<p><b>5.14</b></p> <p>5.14.1</p>	<p><b>Assessment of Tyre Condition and Defects</b></p> <p><i>Study Ref. 2 &amp; 3</i></p> <p>Diagnose from given information or pictures the following tyre conditions:</p> <ul style="list-style-type: none"> <li>a. Normal and serviceable</li> <li>b. Worn out</li> <li>c. Under inflation</li> <li>d. Over inflation</li> <li>e. Open tread splice</li> <li>f. Thrown tread</li> <li>g. Peeled rib</li> <li>h. Tread chunking</li> <li>i. Cut</li> <li>j. Blister and tread separation</li> <li>k. Groove cracking and rib undercutting</li> <li>l. Flaking and chipping</li> <li>m. Skid</li> <li>n. Tread rubber reversion</li> <li>o. Chevron cutting</li> <li>p. Fabric fraying</li> <li>q. Circumferential cracks</li> <li>r. Radial cracks</li> <li>s. Weather checking</li> <li>t. Impact break</li> <li>u. Liner breakdown</li> <li>v. Contamination</li> <li>w. Brake heat damage</li> <li>x. Chaff damage</li> </ul>	<p>3</p>
<p><b>5.15</b></p> <p>5.15.1</p> <p>5.15.2</p> <p>5.15.3</p>	<p><b>Brake Assemblies</b></p> <p><i>Study Ref. 2 &amp; 3</i></p> <p>Describe the construction and principles of operation of the following types of disk brake:</p> <ul style="list-style-type: none"> <li>a. Expander tube (hydraulic and pneumatic)</li> <li>b. Multiple-disk</li> <li>c. Segmented rotor</li> <li>d. Carbon</li> </ul> <p>Give examples of the aircraft types where each brake system may be found.</p> <p>Specify the type of operating system (hydraulic or pneumatic) appropriate to each brake type.</p>	<p>1</p> <p>1</p> <p>1</p>



<b>5.16</b>	<b>Brake System Operation</b> <i>Study Ref. 2 &amp; 3</i>	
5.16.1	Detail the components, layout and principles of operation of the following systems: <ul style="list-style-type: none"> <li>a. Power boosted brake system</li> <li>b. Power brake system</li> <li>c. Independent system</li> <li>d. Power brake control valves</li> <li>e. Pressure ball-check brake control valve</li> <li>f. Brake booster cylinders and their likely location</li> <li>g. Emergency brake system and brake control valve functioning</li> <li>h. Auto-braking systems</li> <li>i. Automatic brake adjustment systems</li> <li>j. Inline valve for isolating the emergency brake system from the normal system</li> <li>k. Brake bleeder valve operation and brake pressure bleeding procedures</li> <li>l. Emergency air brakes</li> <li>m. Master cylinders</li> <li>n. Single and dual servo brakes</li> </ul>	3
<b>5.17</b>	<b>Brake Defects</b> <i>Study Ref. 2 &amp; 3</i>	
5.17.1	Diagnose the causes of the following brake system malfunctions: <ul style="list-style-type: none"> <li>a. Overheating</li> <li>b. Dragging</li> <li>c. Chattering or squealing</li> <li>d. Unequal braking or brake pressure release in a high pressure system</li> </ul>	3
<b>5.18</b>	<b>Monitoring of Brake Temperature</b> <i>Study Ref. 2 &amp; 3</i>	
5.18.1	Describe a typical brake temperature monitoring system and apply limitation charts.	2
5.18.2	Describe the limitations relating to the application of park brakes when main brake assemblies are hot.	2
<b>5.19</b>	<b>Anti-skid Brake Control System</b> <i>Study Ref. 2 &amp; 3</i>	
5.19.1	Specify the purpose and operation of a typical antiskid control system with particular regard to the following factors: <ul style="list-style-type: none"> <li>a. Independent interaction with wheel systems</li> <li>b. Normal skid control</li> <li>c. Locked wheel skid control</li> <li>d. Touchdown protection</li> <li>e. Fail safe protection</li> <li>f. Arming devices and arming sequence</li> <li>g. Function and operation of the anti-skid warning light</li> </ul>	2
5.19.2	State the purpose and operation of the following antiskid system components: <ul style="list-style-type: none"> <li>a. Wheel speed sensors</li> <li>b. Control valves</li> <li>c. Control box</li> <li>d. Pilot control</li> </ul>	2
5.19.3	Describe ground and in-flight testing and maintenance of an antiskid system.	2

<b>6 Pneumatic Systems</b>		
<b>ATA 36</b>		
<b>6.1</b>	<b>Pneumatic System Layout</b>	
	<i>Study Ref. 2, 3 &amp; 4</i>	
6.1.1	Specify a typical medium pressure pneumatic system layout for a modern turbo-prop aircraft with particular emphasis on the relationship and placement of components.	2
6.1.2	Describe a pneumatic emergency brake actuating system for a large transport aircraft with particular emphasis on the relationship and placement of components.	2
6.1.3	Specify aircraft components that would typically be operated by pneumatic power.	2
6.1.4	Describe where pneumatic air is normally vented or dumped during system operation.	2
6.1.5	Compare the advantages of using pneumatics over other aircraft power transmission systems.	2
6.1.6	Compare the fundamental differences between hydraulic and pneumatic systems.	2
6.1.7	Compare the advantages and disadvantages and main differences between high, medium and low pressure pneumatic systems.	2
6.1.8	Describe typical APU and ground cart air supply systems.	2

<b>7 Pressurisation Systems</b>		
<b>ATA 21</b>		
<b>7.1</b>	<b>Terminology</b> <i>Study Ref. 2, 3 &amp; 4</i>	
7.1.1	Define the following terms and explain their application to aircraft pressurisation: <ul style="list-style-type: none"> <li>a. Cabin altitude</li> <li>b. Controlled leaks</li> <li>c. Uncontrolled leaks</li> <li>d. Differential control mode</li> <li>e. Differential pressure</li> <li>f. Isobaric control mode</li> <li>g. Isobaric range</li> <li>h. Maximum differential</li> <li>i. Pressure altitude</li> <li>j. Rate control mode</li> </ul>	3
<b>7.2</b>	<b>Basic System Requirements</b> <i>Study Ref. 2, 3 &amp; 4</i>	
7.2.1	Detail the basic requirements for the successful functioning of a cabin pressurisation system.	3
<b>7.3</b>	<b>Pressurisation System Components</b> <i>Study Ref. 2, 3 &amp; 4</i>	
7.3.1	Determine from diagrams or schematic drawings the following pressurisation components describing their construction and principles of operation: <ul style="list-style-type: none"> <li>a. Positive-displacement cabin compressors (superchargers) and their control devices</li> <li>b. Supercharger instruments</li> <li>c. Centrifugal cabin compressors</li> <li>d. Cabin altimeters</li> <li>e. Cabin differential pressure indicators</li> <li>f. Cabin rate of climb indicators</li> <li>g. Jet pumps</li> <li>h. Negative pressure relief valves</li> <li>i. Outflow valves</li> <li>j. Pneumatic relays</li> <li>k. Cabin air pressure regulators</li> <li>l. Pressure controllers (automatic and manual)</li> <li>m. Safety (positive pressure relief) valves and their operation</li> <li>n. Manually operated safety relief valves</li> <li>o. Safety switches</li> <li>p. Pressurisation controls in the cockpit</li> <li>q. Bleed air</li> <li>r. Turbo-charged bleed air</li> <li>s. Mass flow control</li> <li>t. Temperature control</li> <li>u. Differential pressure</li> <li>v. Maximum pressure</li> </ul>	3
<b>7.4</b>	<b>System Layout</b> <i>Study Ref. 2, 3 &amp; 4</i>	
7.4.1	Describe a typical pressurisation system layout including the pneumatic or electrical interconnection of components.	2

7.4.2	Determine the sources of cabin pressure on both older and modern types of gas turbine and piston-powered aircraft.	3
<b>7.5</b>	<b>Cabin Air Distribution</b> <i>Study Ref. 2, 3 &amp; 4</i>	
7.5.1	Detail a cabin air distribution system that includes the following components or assemblies: <ul style="list-style-type: none"> <li>a. Ducts</li> <li>b. Filters</li> <li>c. Heat exchangers</li> <li>d. Silencers</li> <li>e. Non-return (check) valves</li> <li>f. Humidifiers</li> <li>g. Mass flow control sensors</li> <li>h. Mass flow meters</li> </ul>	3
7.5.2	Describe the importance of fuselage sealing to prevent airflow disruption particularly in critical regions of the cabin.	2
<b>7.6</b>	<b>System Operation</b> <i>Study Ref. 2, 3 &amp; 4</i>	
7.6.1	Describe a pressurisation system in the various modes of operation indicating the functions of the components and the operation various electrical interface and warning/indication systems.	2
7.6.2	Describe how pressure is maintained for a pre-selected altitude.	2
7.6.3	State the factors that are sensed by the cabin pressurisation controller during normal operation of the system.	2
<b>7.7</b>	<b>Fault Finding and Maintenance</b> <i>Study Ref. 2, 3 &amp; 4</i>	
7.7.1	Diagnose faults in aircraft pressurisation systems including the electrical and instrument interface and indicate how these faults can be rectified.	3

<b>8 Air-conditioning Systems</b>		
<b>ATA 21</b>		
<b>8.1</b>	<b>General Functions</b> <i>Study Ref. 2, 3 &amp; 4</i>	
8.1.1	Detail the functions and requirements of an air-conditioning system.	3
<b>8.2</b>	<b>Air-Conditioning Principles and Terminology</b> <i>Study Ref. 2, 3 &amp; 4</i>	
8.2.1	Define the following terms as they apply specifically to cabin atmosphere control systems: <ul style="list-style-type: none"> <li>a. Adiabatic</li> <li>b. Conduction</li> <li>c. Convection</li> <li>d. Humidity</li> <li>e. Latent heat</li> <li>f. Latent heat of vaporisation</li> <li>g. Radiation</li> <li>h. Relative humidity</li> <li>i. Sensible heat</li> <li>j. Superheat</li> </ul>	1
<b>8.3</b>	<b>Vapour Cycle System</b> <i>Study Ref.</i>	
8.3.1	Describe the construction and operation of the following vapour cycle system components: <ul style="list-style-type: none"> <li>a. Blowers</li> <li>b. Compressors</li> <li>c. Condensers</li> <li>d. Evaporators</li> <li>e. Expansion valves</li> <li>f. Isolation valves</li> <li>g. Receiver-dryers</li> <li>h. Superheaters and subcoolers</li> </ul>	3
8.3.2	Describe the construction features, principles of operation, location and function within a typical system of the above components.	2
8.3.3	Describe the types and characteristics of refrigerants and oils used in an air conditioning system.	2
8.3.4	Identify and state the function of the valves, gauges, fittings and hoses of a vapour cycle servicing manifold set.	2
8.3.5	Describe the procedures and list the equipment used to carry out purging and charging of the system.	2
8.3.6	State precautions necessary for the safe servicing of a vapour cycle system.	2
8.3.7	Describe the procedures and list the equipment used to carry out leak tests, checking compressor oil and evacuating the system.	2
8.3.8	Identify and name the procedures to rectify faults in vapour cycle systems.	2
8.3.9	State the environmental requirements associated with the use of air conditioning fluids.	2

<b>8.4</b>	<b>Air-Cycle System Components</b> <i>Study Ref. 2, 3 &amp; 4</i>	
8.4.1	From given schematic drawings, determine the relationships of the following air-cycle system components and explain their operating principles: <ul style="list-style-type: none"> <li>a. Air-cycle machines</li> <li>b. Flow control valves</li> <li>c. Expansion turbine</li> <li>d. Heat exchangers</li> <li>e. Primary heat exchanger</li> <li>f. Humidifiers</li> <li>g. Mixing chambers and mixing valves</li> <li>h. Pressure regulation valves</li> <li>i. Recirculation fans</li> <li>j. Recirculation filters</li> <li>k. Silencers</li> <li>l. Spill valves</li> <li>m. Water separators (high and low pressure)</li> <li>n. Coalescent bags</li> </ul>	3
<b>8.5</b>	<b>Basic Air-Cycle System Layout and Operation</b> <i>Study Ref. 2, 3 &amp; 4</i>	
8.5.1	Identify by name and state the function of components in the basic air-cycle system.	2
8.5.2	Trace the airflow through the various schematic layouts provided.	2
<b>8.6</b>	<b>Typical Aircraft Air-Cycle System Layout, Operation and Fault Finding</b> <i>Study Ref. 2, 3 &amp; 4</i>	
8.6.1	From given information, describe the operation and trace airflows in given configurations including the electrical and instrument interface.	2
<b>8.7</b>	<b>Temperature Control and Air Distribution</b> <i>Study Ref. 2, 3 &amp; 4</i>	
8.7.1	Describe desired airflow paths in occupied cabins.	2
8.7.2	Determine provisions for emergency and ground ventilation in given schematics.	3
8.7.3	From given information, describe the operation of a trim air system.	2
8.7.4	Describe the operating principles of gasper (eyeball) vents and the system.	2
8.7.5	Describe the operating principles of cabin temperature control systems and identify appropriate sensor locations that contribute to stable temperature control.	2
8.7.6	Specify how and where thermistors would be used as a cabin temperature-sensing device.	2

8.7.7	Describe the principles of operation of a typical combustion type heater used in pressurised aircraft including the following features: a. Output temperature control b. Fuel control c. Ignition control d. Ventilation e. Fire protection f. Carbon monoxide testing g. Heater operating cycles h. Trouble shooting i. Defect rectification	2
8.7.8	State how cabin humidity is controlled with respect to the following criteria. Reasons for humidification Water separation Humidity control system layout including interface with other cabin air-conditioning systems Humidity control devices	2

<b>9 Oxygen Systems</b>		
<b>ATA 35</b>		
<b>9.1</b>	<b>General</b> <i>Study Ref. 2, 3 &amp; 4</i>	
9.1.1	Define hypoxia, anoxia, hyperventilation and carbon monoxide poisoning and the symptoms applying to them.	2
<b>9.2</b>	<b>Forms of Oxygen</b> <i>Study Ref. 2, 3 &amp; 4</i>	
9.2.1	Describe the following forms of oxygen as used in aviation: a. Gaseous b. Liquid c. Chemical or solid state d. Mechanically separated	1
9.2.2	Distinguish the differences between aviation breathing oxygen and oxygen available for commercial or medical use.	3
<b>9.3</b>	<b>Oxygen System and Associated Components</b> <i>Study Ref. 2, 3 &amp; 4</i>	
9.3.1	Detail the purpose, construction and operation of the following oxygen system components: a. High and low pressure cylinders b. Manual continuous flow regulators c. Automatic continuous flow regulators d. Demand regulators e. Diluter demand regulators f. Pressure demand regulators g. Airflow metering aneroid h. Continuous flow masks, re breather type masks or bags i. Demand type masks j. Filler valves k. Pressure gauges l. Continuous flow couplings m. Flow indicators n. Oxygen plumbing including materials used for rigid pipes and fittings o. Smoke protection equipment p. Passenger service units q. Charging valves r. Quantity and pressure indicators	3
<b>9.4</b>	<b>Continuous Flow and Pressure Demand Systems</b> <i>Study Ref. 2, 3 &amp; 4</i>	
9.4.1	Detail the construction, layout and purpose of continuous flow and pressure demand oxygen systems.	3
9.4.2	Specify how flow testing is carried out for each system.	2



<b>9.5</b>	<b>Chemical Oxygen Systems</b> <i>Study Ref. 2, 3 &amp; 4</i>	
9.5.1	Describe the construction, layout and operation of a typical chemical oxygen system with regard to the following criteria: a. Candle construction b. Performance characteristics c. Precautions	2
<b>9.6</b>	<b>Portable Oxygen Equipment</b> <i>Study Ref. 2, 3 &amp; 4</i>	
9.6.1	Describe the construction, operation, performance limitations and uses of portable oxygen equipment.	2
9.6.2	Specify how the contents of portable oxygen cylinders are checked.	2
<b>9.7</b>	<b>System Advantages</b> <i>Study Ref. 2, 3 &amp; 4</i>	
9.7.1	Identify the features and compare the advantages and disadvantages of solid state versus high-pressure gaseous oxygen systems.	2
9.7.2	Describe the type of system most commonly used for crew oxygen.	2
<b>9.8</b>	<b>Oxygen System Servicing and Precautions</b> <i>Study Ref. 2, 3 &amp; 4</i>	
9.8.1	Explain oxygen system servicing with particular regard to the following factors: a. Leak testing of gaseous oxygen systems and the materials that may be used b. Used graphs or other technical data to establish leak rates against system gauge pressure c. Cleaning system components d. Draining of the system e. Purging the system and the purging gasses normally used f. Filling the system g. Pressure/ temperature correction h. Filling a LOX system i. Inspecting masks and hoses j. Replacing tubing, valves and fittings k. Clearance between oxygen lines and electrical wiring l. Testing and lifing of cylinders and other components m. Typical system inspection and maintenance procedures n. Maintenance of a typical oxygen dispensing trolley o. Breathing oxygen cylinder identification (colour and lettering) p. Flaring and the types of flare used for rigid oxygen system lines q. Typical charge pressures for the various types of oxygen cylinder r. Colour code identification of oxygen system lines s. Testing of oxygen systems t. Use and maintenance of oxygen test equipment	3
9.8.2	Determine precautions to be taken to prevent oxygen fires and explosions.	3

<b>10 Ice and Rain Protection Systems</b>		
<b>ATA 30</b>		
<b>10.1</b>	<b>General</b> <i>Study Ref. 2, 3 &amp; 4</i>	
10.1.1	Explain the types and formation processes relating to ice normally encountered in aircraft operations.	2
10.1.2	Determine the parts of an aircraft normally susceptible to ice formation.	3
10.1.3	Detail the means employed on modern aircraft to prevent or control ice formation.	3
10.1.4	Explain the effects icing has on the operation or performance of an aeroplane and the difference between anti-ice and de-icing systems.	2
<b>10.2</b>	<b>Ice Detecting Devices</b> <i>Study Ref. 2, 3 &amp; 4</i>	
10.2.1	Detail the operation of the various types of ice detecting devices.	3
<b>10.3</b>	<b>Pneumatic De Ice System</b> <i>Study Ref. 2, 3 &amp; 4</i>	
10.3.1	Detail the construction and operation of a typical pneumatic de-icing system with particular regard to the following criteria: <ul style="list-style-type: none"> <li>a. Sources of operating air</li> <li>b. Configurations of pneumatic de-icer boots</li> <li>c. De-icer boot inflation cycle</li> <li>d. De-icer boot construction and installation</li> <li>e. Solenoid distributor valve</li> <li>f. Pumps</li> <li>g. Suction regulating valves</li> <li>h. Cockpit pressure and vacuum gauge indications when system operating normally</li> <li>i. Unloading valves</li> <li>j. Relief valves</li> <li>k. Separators</li> <li>l. Shuttle valves</li> <li>m. Timers</li> <li>n. Retention of boots in the closed position when the system not operating</li> </ul>	3
<b>10.4</b>	<b>Pneumatic De-Ice System Maintenance</b> <i>Study Ref. 2, 3 &amp; 4</i>	
10.4.1	Detail typical inspections and operational checks associated with a pneumatic de-icing system.	3
10.4.2	Describe typical de-icer boot repairs including the preparation of rubber and metal surfaces prior to boot installation.	2
10.4.3	Specify how de-icer boots may be protected from damage or deterioration while in service or in storage.	2
10.4.4	Detail typical de-icer system defects or malfunctions specifying associated causes and remedies.	3

<b>10.5</b>	<b>Thermal Anti-Ice Systems</b> <i>Study Ref. 2, 3 &amp; 4</i>	
10.5.1	Detail the construction and operation of thermal anti-ice systems with particular regard to the following: a. Wing anti-ice b. Engine inlet anti-ice c. Windshield anti-ice d. Antenna anti-ice e. Source of anti-ice air f. Temperature control devices	3
10.5.2	Describe the components of a laminated integral electrically heated windshield system.	2
10.5.3	Detail the operation of a typical pitot head anti-ice system including physical and electrical procedures and precautions for ground testing.	3
10.5.4	Diagnose the cause of overheating and arcing in an electrically heated windshield panel.	3
10.5.5	Describe the operation of a typical water and toilet drain heating system.	2
<b>10.6</b>	<b>Chemical (Fluid) De-icing systems</b> <i>Study Ref. 2, 3 &amp; 4</i>	
10.6.1	Detail the construction, and operation of a typical chemical de-icing system including the typical composition of the fluid used.	3
10.6.2	Detail the operation of a typical windshield de-icing system.	3
10.6.3	Describe the requirements for ground de-icing of aircraft, the chemicals used, and the precautions associated with the use of de-ice chemicals.	2
<b>10.7</b>	<b>Rain Control Systems</b> <i>Study Ref. 2, 3 &amp; 4</i>	
10.7.1	Detail the principles of operation and system layout of the following types of windscreen rain removal systems: a. Wiper b. Repellent (Chemical) c. Hot air (Pneumatic)	3
10.7.2	Describe the installation and adjustment of electric and hydraulic windscreen wiper systems.	2
10.7.3	Specify how a pneumatic rain removal may be functionally tested.	2
10.7.4	Describe the operation of various types of windscreen demisting systems found on modern aircraft.	2

<b>11 Fuel Systems</b>		
<b>ATA 28</b>		
<b>11.1</b>	<b>General</b>	
	<i>Study Ref. 2, 3 &amp; 4</i>	
11.1.1	Detail the layout of an air transport aircraft fuel system with particular regard to the following criteria: <ul style="list-style-type: none"> <li>a. Standard symbols used to depict components</li> <li>b. Integral fuel tank construction</li> <li>c. Purpose of baffles in an integral fuel tank</li> <li>d. Cross feeding</li> <li>e. Fuel shut off</li> <li>f. Emergency fire shut-off valves</li> <li>g. Fuel dumping/jettison including the typical numbers and locations of dump chutes.</li> <li>h. Fuel heating</li> <li>i. Fuel icing indication devices</li> <li>j. Strainers and filters</li> <li>k. Booster and backing pumps including submerged single-speed centrifugal types</li> <li>l. Fuel pumps</li> <li>m. Fuelling stations</li> <li>n. Valves</li> <li>o. Electrically operated devices</li> <li>p. Fuel tank transfer or "flapper" valves</li> <li>q. Scavenging and jet pumps</li> <li>r. Ejector pumps</li> </ul>	3
11.1.2	Describe how fuel is used for aircraft trim.	2
<b>11.2</b>	<b>Fuel System Maintenance</b>	
	<i>Study Ref. 2, 3 &amp; 4</i>	
11.2.1	Determine the following factors relating to aircraft fuel systems: <ul style="list-style-type: none"> <li>a. Re fuelling and de fuelling procedures</li> <li>b. Function of a drip gauge and sight gauge for measurement of fuel tank contents</li> <li>c. The effects and control of static electricity</li> <li>d. The cause and control of micro organisms in fuel tanks</li> <li>e. Fuel leak classification</li> <li>f. Fire safety and hazard identification when re fuelling and de fuelling large aircraft</li> <li>g. Fuel system contaminants likely to affect large jet and turbo-prop aircraft</li> <li>h. Removal of entrained and the hazards associated with water accumulation in the fuel filters of gas turbine powered aircraft</li> <li>i. Gas to be used when purging an aircraft fuel tank</li> <li>j. Regulation of booster pump pressure</li> <li>k. Procedures and precautions associated with working inside aircraft fuel tanks</li> <li>l. Colour code identification of fuel pipes and lines</li> </ul>	3
11.2.2	Detail precautions to be observed when pressure refuelling from hydrants or trucks.	3
<b>11.3</b>	<b>Fuel Contents and Flow Measurement</b>	
	<i>Study Ref. 2, 3 &amp; 4</i>	
11.3.1	Detail the construction and operation of a fuel contents and flow measurement system for a large jet and turbo-prop aircraft.	3

11.3.2	State why fuel quantity is more likely specified in pounds rather than gallons on gas turbine powered transport aircraft.	2
11.3.3	Detail the operation of a capacitance contents indicating system with particular regard to the following features: a. Probe construction including dielectric b. Contents calibration c. Electrical circuit d. Trouble shooting and defect rectification	3

<b>12 Fire Detection and Extinguishing Systems</b>		
<b>ATA 26</b>		
<b>12.1</b>	<b>General</b> <i>Study Ref. 2, 3 &amp; 4</i>	
12.1.1	Describe the fire triangle and give practical aviation related examples.	2
12.1.2	Detail the construction, operation, testing, troubleshooting and maintenance of the following types of fire detection system: a. Continuous element or pressure type sensor responder b. Continuous loop (fire wire) c. Thermal switch d. Thermocouple e. Infra red	3
12.1.3	Detail the operation, layout, troubleshooting, maintenance and safety precautions of typical aircraft fire extinguishing systems and components.	3
<b>12.2</b>	<b>Fixed Fire Extinguishing Systems</b> <i>Ref. 2, 3 &amp; 4</i>	
12.2.1	Detail typical aeroplane fixed fire extinguishing systems.	3
<b>12.3</b>	<b>Portable Fire Extinguishing Systems</b> <i>Study Ref. 2, 3 &amp; 4</i>	
12.3.1	Describe typical portable fire extinguishers in aviation use.	1
<b>12.4</b>	<b>Inspection and Maintenance</b> <i>Study Ref. 2, 3 &amp; 4</i>	
12.4.1	Detail the inspection and maintenance requirements and precautions of both detection and extinguishing systems including system tests and life limitations of fire extinguisher components.	3
<b>12.5</b>	<b>Extinguisher Agents</b> <i>Study Ref. 2, 3 &amp; 4</i>	
12.5.1	Determine the various types of fire extinguisher and extinguishing agents, used in aviation.	3
12.5.2	Explain their individual uses, advantages and disadvantages, precautions, restrictions and maintenance requirements after extinguisher activation.	3
<b>12.6</b>	<b>Smoke Detection</b> <i>Study Ref. 2, 3 &amp; 4</i>	
12.6.1	Detail the construction and operation of the following smoke detection systems: a. Carbon monoxide b. Photoelectric c. Visual d. Infra red	3

<b>12.7</b>	<b>Master Central Warning Systems</b>	
	<i>Study Ref. 2, 3 &amp; 4</i>	
12.7.1	Describe the operation and indications (oral and visual) provided by typical master central warning systems including principles of inputs-outputs and priority philosophy.	2

<b>13 Reliability Fundamentals and Aircraft Structural Maintenance Concepts</b>		
<b>13.1</b>	<b>Terminology</b> <i>Study Ref. 6</i>	
13.1.1	Describe the following reliability terms and concepts and know where they would be applied to the maintenance of modern jet and turbo-prop air transport aircraft: <ul style="list-style-type: none"> <li>a. Maintenance Steering Group MSG2 and MSG3</li> <li>b. Design concepts FAR 23 and 25</li> <li>c. Factor of safety</li> <li>d. Damage tolerance</li> <li>e. Fail-safe</li> <li>f. Safe life</li> <li>g. Safe-life evaluation</li> <li>h. Single load paths</li> <li>i. Multiple Load Paths.</li> <li>j. Structural deterioration through fatigue.</li> <li>k. Corrosion stress corrosion cracking impact</li> <li>l. Damage, abrasion/erosion, wear, and lack of cleanliness</li> <li>m. Methods of limiting structural deterioration</li> <li>n. Redundancy</li> <li>o. Maintenance criteria including hard time, on condition and condition monitoring</li> <li>p. Scheduled maintenance</li> <li>q. Unscheduled maintenance</li> <li>r. The meaning and importance of reliability</li> <li>s. Overhaul</li> <li>t. Time in service</li> </ul>	1
<b>13.2</b>	<b>Failure</b> <i>Study Ref. 6</i>	
13.2.1	Specify the following failure considerations: <ul style="list-style-type: none"> <li>a. Failure detection methods</li> <li>b. Consequences of failure</li> <li>c. Failure rates</li> <li>d. Mean time between failure (MTBF)</li> <li>e. Wear-in and infant mortality</li> </ul>	2
13.2.2	Identify the causes and indicators of fatigue failure in aircraft structure including stress raisers and common design or manufacturing deficiencies.	2
<b>13.3</b>	<b>Maintenance Programmes</b> <i>Study Ref. 6 &amp; AC90-1 (NZCAA)</i>	
13.3.1	Identify the concepts and application of the following maintenance programmes: <ul style="list-style-type: none"> <li>a. Equalised maintenance</li> <li>b. Opportunity maintenance</li> <li>c. Centralised/decentralised maintenance</li> <li>d. Structural inspection programmes</li> <li>e. Supplementary inspection programmes</li> <li>f. Ageing aircraft inspection programmes</li> <li>g. ETOPS and EROPS maintenance and inspection programmes</li> </ul>	1
13.3.2	Describe typical maintenance programmes associated with the following: <ul style="list-style-type: none"> <li>a. Aging aircraft</li> <li>b. Controlling structural fatigue</li> <li>c. Controlling corrosion</li> </ul>	1



<p><b>13.4</b></p> <p>13.4.1</p>	<p><b>Quality Fundamentals</b></p> <p><i>Study Ref. 6 &amp; AC120-01 (NZCAA)</i></p> <p>Describe the following quality and safety fundamentals:</p> <ul style="list-style-type: none"> <li>a. Quality assurance</li> <li>b. Quality control</li> <li>c. Responsibilities and functions of a QA department</li> <li>d. Internal quality and safety auditing programmes</li> <li>e. Preventative and corrective actions</li> <li>f. Process control and the development of procedures and work instructions.</li> <li>g. Quality manuals</li> <li>h. Latent failure</li> </ul>	<p>2</p>
<p><b>13.5</b></p> <p>13.5.1</p> <p>13.5.2</p>	<p><b>Service Data</b></p> <p><i>Study Ref. 2, 3 &amp; 4</i></p> <p>Describe the following criteria relating to the maintenance of aircraft and aircraft components:</p> <ul style="list-style-type: none"> <li>a. Service information including bulletins, instructions and letters</li> <li>b. Structural repair manuals</li> <li>c. Approved and acceptable technical data</li> <li>d. Defect investigation, analysis and reporting documentation</li> <li>e. Conformity inspection requirements</li> <li>f. Classification of major modification and major repair</li> </ul> <p>Describe the following criteria pertaining to onboard maintenance systems:</p> <ul style="list-style-type: none"> <li>a. Central maintenance computers</li> <li>b. Data loading</li> <li>c. Electronic library system</li> <li>d. Printing</li> <li>e. Structure monitoring (damage tolerance monitoring)</li> </ul>	<p>2</p> <p>1</p>