

1. Title	Aeroplane aerodynamics, structures and systems II (Mechanics Repair and Maintenance)
2. Code	EMAMBA504A
3. Range	The knowledge is needed for a wide range of aeroplane repair and maintenance works, e.g. applicable to aircrafts, analysis, machineries, airworthiness, airframes, avionics, materials, tests, documentation, safety, health and tools etc.
4. Level	5
5. Credit	3
6. Competency	<p style="text-align: center;"><u>Performance Requirement</u></p> <p>6.1 Knowledge</p> <ul style="list-style-type: none"> <li>◆ Able to understand the theory of aeroplane aerodynamics and flight controls <ul style="list-style-type: none"> <li>• Operation and effect of of: <ul style="list-style-type: none"> <li>▸ Roll control: ailerons and spoilers.</li> <li>▸ Pitch control: elevators, stabilators, variable incidence stabilisers and canards.</li> <li>▸ Yaw control, rudder limiters.</li> </ul> </li> <li>• Control using elevons, ruddervators.</li> <li>• High lift devices, slots, slats, flaps, flaperons.</li> <li>• Drag inducing devices, spoilers, lift dumpers, speed brakes.</li> <li>• Effects of wing fences, saw tooth leading edges.</li> <li>• Boundary layer control using, vortex generators, stall wedges or leading edge devices.</li> <li>• Operation and effect of trim tabs, balance and antibalance (leading) tabs, servo tabs, spring tabs, mass balance, control surface bias, aerodynamic balance panels.</li> </ul> </li> </ul>

- ◆ Able to understand the theory of high speed flight
  - Speed of sound, subsonic flight, transonic flight, supersonic flight, Mach number, critical Mach number, compressibility buffet, shock wave, aerodynamic heating, area rule.
  - Factors affecting airflow in engine intakes of high speed aircraft.
  - Effects of sweepback on critical Mach number.
- ◆ Able to understand the general concept of the airframe structures
  - Airworthiness requirements for structural strength.
    - Structural classification, primary, secondary and tertiary.
    - Fail safe, safe life, damage tolerance concepts.
    - Zonal and station identification systems.
    - Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue.
    - Drains and ventilation provisions.
    - System installation provisions.
    - Lightning strike protection provision.
  - Construction methods of: stressed skin fuselage, formers, stringers, longerons, bulkheads, frames, doublers, struts, ties, beams, floor structures, reinforcement, methods of skinning, anti-corrosive protection, wing, empennage and engine attachments.

- Structure assembly techniques: riveting, bolting, bonding.
- Methods of surface protection, such as chromating, anodising, painting.
- Surface cleaning.
- Airframe symmetry: methods of alignment and symmetry checks.
- ◆ Able to understand the aeroplanes airframe structures
  - Fuselage (ATA 52/53/56)
    - Construction and pressurisation sealing.
    - Wing, stabiliser, pylon and undercarriage attachments.
    - Seat installation and cargo loading system.
    - Doors: construction, mechanisms, operation and safety devices.
    - Windows and windscreen construction and mechanisms.
  - Wings (ATA 57)
    - Construction.
    - Fuel storage.
    - Landing gear, pylon, control surface and high lift/drag attachments.
  - Stabilisers (ATA 55)
    - Construction.
    - Control surface attachment.
  - Flight control surfaces (ATA 55/57)
    - Construction and attachment.
    - Balancing - mass and aerodynamic.
  - Nacelles/Pylons (ATA 54)
    - Construction.
    - Firewalls.
    - Engine mounts.

- ◆ Able to understand the air conditioning and cabin pressurisation (ATA 21)
  - Air supply
    - Sources of air supply including engine bleed, APU and ground cart.
  - Air conditioning
    - Air conditioning systems.
    - Air cycle and vapour cycle machines.
    - Distribution systems.
    - Flow, temperature and humidity control system.
  - Pressurisation
    - Pressurisation systems.
    - Control and indication including control and safety valves.
    - Cabin pressure controllers.
  - Safety and warning devices
    - Protection and warning devices.
- ◆ Able to understand the Instruments/Avionic Systems
  - Instrument Systems (ATA 31)
    - Pitot static: altimeter, air speed indicator, vertical speed indicator.
    - Gyroscopic: artificial horizon, attitude director, direction indicator, horizontal situation indicator, turn and slip indicator, turn coordinator.
    - Compasses: direct reading, remote reading.
    - Compass compensation and adjustment.
    - Angle of attack indication, stall warning systems.
    - Other aircraft system indication.

- Avionic Systems
  - › Fundamentals of system lay-outs and operation of:
  - › Auto Flight (ATA 22).
  - › Communications (ATA 23).
  - › Navigation Systems (ATA 34).
- ◆ Able to understand the electrical power (ATA 24)
  - Batteries Installation and Operation.
  - DC power generation.
  - AC power generation.
  - Emergency power generation.
  - Voltage regulation.
  - Power distribution.
  - Inverters, transformers, rectifiers.
  - Circuit protection.
  - External / Ground power.
- ◆ Able to understand the equipment and furnishings (ATA 25)
  - Emergency equipment requirements.
    - › Seats, harnesses and belts.
  - Cabin lay-out.
    - › Equipment lay-out.
    - › Cabin Furnishing Installation.
    - › Cabin entertainment equipment.
    - › Galley installation.
    - › Cargo handling and retention equipment.
    - › Airstairs.
- ◆ Able to understand the fire protection (ATA 26)
  - Fire and smoke detection and warning systems.
  - Fire extinguishing systems.
  - System tests.

- ◆ Able to understand the flight controls (ATA 27)
  - Primary controls: aileron, elevator, rudder, spoiler.
  - Trim control.
  - Active load control.
  - High lift devices.
  - Lift dump, speed brakes.
  - System operation: manual, hydraulic, pneumatic, electrical, fly-by-wire.
  - Artificial feel, Yaw damper, Mach trim, rudder limiter, gust locks.
  - Balancing and rigging.
  - Stall protection system.
- ◆ Able to understand the fuel systems (ATA 28)
  - System lay-out.
  - Fuel tanks.
  - Supply systems.
  - Dumping, venting and draining.
  - Cross-feed and transfer, Indications and warnings.
  - Refuelling and defuelling.
  - Longitudinal balance fuel systems.
- ◆ Able to understand the hydraulic power (ATA 29)
  - System lay-out.
  - Hydraulic fluids.
  - Hydraulic reservoirs and accumulators.
  - Pressure generation: electric, mechanical, pneumatic.
  - Emergency pressure generation.
  - Pressure Control.
  - Power distribution.
  - Indication and warning systems.
  - Interface with other systems.

- ◆ Able to understand the ice and rain protection (ATA 30)
  - Ice formation, classification and detection.
  - Anti-icing systems: electrical, hot air and chemical.
  - De-icing systems: electrical, pneumatic and chemical.
  - Rain repellent and removal.
  - Probe and drain heating.
- ◆ Able to understand the landing gear (ATA 32)
  - Construction, shock absorbing.
  - Extension and retraction systems: normal and emergency.
  - Indications and warning.
  - Wheels, brakes, antiskid and autobraking.
  - Tyres.
  - Steering.
- ◆ Able to understand the lights system (ATA 33)
  - External: navigation, anti-collision, landing, taxiing, ice.
  - Internal: cabin, cockpit, cargo.
  - Emergency.
- ◆ Able to understand the oxygen system (ATA 35)
  - System lay-out: cockpit, cabin.
  - Sources, storage, charging and distribution.
  - Supply regulation.
  - Indications and warnings.
- ◆ Able to understand the pneumatic/vacuum (ATA 36)
  - System lay-out.

	<ul style="list-style-type: none"> <li>• Sources: engine / APU, compressors, reservoirs,</li> <li>• ground supply.</li> <li>• Pressure control.</li> <li>• Distribution.</li> <li>• Indications and warnings.</li> <li>• Interfaces with other systems.</li> <li>◆ Able to understand the Water/Waste (ATA 38) <ul style="list-style-type: none"> <li>• Water system lay-out, supply, distribution, servicing and draining.</li> <li>• Toilet system lay-out, flushing and servicing.</li> <li>• Corrosion aspects.</li> </ul> </li> <li>◆ Able to understand the On Board Maintenance Systems (ATA 45) <ul style="list-style-type: none"> <li>• Central maintenance computers.</li> <li>• Data loading system.</li> <li>• Electronic library system.</li> <li>• Printing.</li> <li>• Structure monitoring (damage tolerance monitoring).</li> </ul> </li> </ul> <p>6.2 Theoretical and practical aspects</p> <ul style="list-style-type: none"> <li>◆ Able to apply the following knowledge in the aircraft maintenance. <ul style="list-style-type: none"> <li>• Theory of flight.</li> <li>• General concepts of airframe structures</li> <li>• Aeroplanes airframe structures</li> <li>• Air conditioning and cabin pressurisation (ATA 21)</li> <li>• Instrument systems (ATA 31)</li> <li>• Electrical power (ATA 24)</li> <li>• Equipment and furnishings (ATA 25)</li> <li>• Fire protection (ATA 26)</li> <li>• Flight controls (ATA 27)</li> <li>• Fuel systems (ATA 28)</li> </ul> </li> </ul>
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	<ul style="list-style-type: none"> <li>• Hydraulic power (ATA 29).</li> <li>• Ice and rain protection (ATA 30).</li> <li>• Landing gear (ATA 32).</li> <li>• Lights (ATA 33).</li> <li>• Oxygen (ATA 35).</li> <li>• Pneumatic/Vacuum (ATA 36).</li> <li>• Water/Waste (ATA 38).</li> <li>• On board maintenance systems (ATA 45).</li> </ul> <p>6.3 Professional approach</p> <ul style="list-style-type: none"> <li>◆ Able to understand the principal elements of the subjects.</li> <li>◆ Able to understand the general knowledge of the theoretical and practical aspects of the following subjects. <ul style="list-style-type: none"> <li>• Aeroplane aerodynamics and flight controls.</li> <li>• High speed flight.</li> <li>• General concepts of airframe structures</li> <li>• Aeroplanes airframe structures</li> <li>• Air supply of air conditioning.</li> <li>• Instrument systems (ATA 31).</li> <li>• Equipment and furnishings (ATA 25).</li> <li>• On board maintenance systems (ATA 45).</li> </ul> </li> <li>◆ Able to apply the knowledge in the aircraft maintenance task.</li> <li>◆ Able to understand the detailed knowledge of the theoretical and practical aspects of the following subjects. <ul style="list-style-type: none"> <li>• Air conditioning and cabin pressurisation (ATA 21). <ul style="list-style-type: none"> <li>▸ Air conditioning.</li> <li>▸ Pressurisation.</li> <li>▸ Safety and warning devices.</li> </ul> </li> <li>• Electrical power (ATA 24).</li> <li>• Fire protection (ATA 26).</li> </ul> </li> </ul>
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	<ul style="list-style-type: none"> <li>• Flight controls (ATA 27).</li> <li>• Fuel systems (ATA 28).</li> <li>• Hydraulic power (ATA 29).</li> <li>• Ice and rain protection (ATA 30).</li> <li>• Landing gear (ATA 32).</li> <li>• Lights (ATA 33).</li> <li>• Oxygen (ATA 35).</li> <li>• Pneumatic/Vacuum (ATA 36).</li> <li>• Water/Waste (ATA 38).</li> </ul> <p>◆ Able to combine and apply the separate elements of knowledge in a logical and comprehensive manner.</p>
7. Assessment Criteria	<p>The integral outcomes requirement of this UoC are:</p> <ul style="list-style-type: none"> <li>(i) Able to understand the theory of the subjects and interrelationships with other subjects.</li> <li>(ii) Able to give a detailed description of the subject using theoretical fundamentals and specific examples.</li> <li>(iii) Able to understand and be able to use mathematical formulae related to the subject.</li> <li>(iv) Able to read, understand and prepare sketches, simple drawings and schematics describing the subject.</li> <li>(v) Able to apply the knowledge relating to mechanics repair and maintenance in a practical manner using manufacturer's instructions.</li> <li>(vi) Able to interpret results from various sources and measurements and apply corrective action where appropriate.</li> </ul>
8. Remarks	Ref: HKAR-66 Module 11: Aeroplane aerodynamics, structures and systems