Accredited Africa Training Institute for Capacity Development
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COURSE BROCHURE

Helicopter Aerodynamics Fundamentals

Physical, Mathematical, Computer and Life Sciences / Physical Sciences

Unit Standard 243737 · NQF Level 5 · 12 Credits · 9 Days

COURSE OVERVIEW

This course provides a comprehensive understanding of helicopter aerodynamics, enabling learners to apply aerodynamic principles to helicopter operations. It covers the fundamental forces, rotor dynamics, and performance factors essential for safe and efficient flight.

Category	Physical, Mathematical, Computer and Life Sciences
Subfield	Physical Sciences
Unit Standard	243737
Accreditation	SAQA Accredited · NQF Level 5 · 12 Credits
Duration	9 days
Training Method	Online, On-Campus, In-House
Certificate	Issued via AATICD LMS — verifiable online

LEARNING OUTCOMES

- Demonstrate an understanding of the principles of lift, thrust, drag, and weight in helicopter flight.
- Analyze the effects of rotor blade design and airflow on helicopter performance.
- Evaluate the impact of environmental factors such as altitude and temperature on helicopter aerodynamics.
- Apply aerodynamic principles to interpret flight manual data and optimize flight operations.
- Demonstrate understanding of autorotation and its role in emergency procedures.

WHO SHOULD ATTEND

- This course is designed for helicopter pilots, maintenance engineers, and aviation professionals seeking to deepen their knowledge of helicopter aerodynamics.

COURSE OUTLINE

Day 1: Introduction to Helicopter Aerodynamics

- Overview of helicopter design and configuration
- Basic aerodynamic terms: lift, drag, thrust, weight
- Newton's laws of motion applied to rotorcraft
- Rotor system types: fully articulated, semi-rigid, rigid
- Forces in equilibrium: hover and forward flight
- Introduction to blade element theory
- Relative airflow and angle of attack
- Comparison with fixed-wing aerodynamics

Day 2: Rotor Aerodynamics – Hover

- Momentum theory for hover
- Blade element theory in hover
- Induced velocity and inflow ratio
- Thrust coefficient and power coefficient
- Figure of merit and rotor efficiency
- Ground effect: in-ground-effect (IGE) and out-of-ground-effect (OGE
- Effects of density altitude on hover
- Power required curves for hover

Day 3: Rotor Aerodynamics – Vertical and Forward Flight

- Vertical climb: induced velocity and power
- Vertical descent: vortex ring state and settling with power
- Autorotation: entry, steady state, and flare
- Forward flight: translational lift and effective translational lift
- Dissymmetry of lift and flapping to equality
- Retreating blade stall and limitations
- Power required versus airspeed curve
- Factors affecting forward flight performance

Day 4: Rotor Systems and Controls

- Main rotor head design: teetering, hingeless, bearingless
- Tail rotor types: conventional, Fenestron, NOTAR
- Cyclic control: pitch link and swashplate operation
- Collective control: collective lever and pitch change
- Anti-torque pedals and tail rotor thrust
- Blade articulation: flapping, lead-lag, feathering
- Control system components: push-pull tubes, cables, hydraulic actuators
- Control mixing and rigging principles

Day 5: Helicopter Performance

- Hover performance: IGE and OGE hover ceilings
- Climb performance: rate of climb, climb gradient
- Cruise performance: range and specific range
- Endurance: maximum endurance and fuel flow
- Factors affecting performance: gross weight, density altitude, wind

- Height-velocity diagram: avoid region
- Performance charts and data interpretation
- Limitations and safety margins

Day 6: Stability and Control

- Static stability: longitudinal, lateral, directional
- Dynamic stability: phugoid, Dutch roll, spiral modes
- Rotor contributions to stability: flapping, hinge offset
- Horizontal and vertical stabilizers
- Stability augmentation systems (SAS
- Automatic flight control systems (AFCS
- Handling qualities ratings (Cooper-Harper scale
- Trim and control harmony

Day 7: Rotor Dynamics and Vibrations

- Sources of vibration: main rotor, tail rotor, engine, transmission
- Rotor tracking: vertical and lead-lag tracking
- Rotor balancing: static and dynamic
- Ground resonance: causes and prevention
- Air resonance: coupled rotor-fuselage modes
- Vibration damping: elastomeric dampers, hydraulic dampers
- Vibration analysis and measurement
- Tuning and vibration reduction methods

Day 8: Special Flight Conditions and Limitations

- Vortex ring state (settling with power): causes and recovery
- Dynamic rollover: mechanics and avoidance
- Low-G conditions and mast bumping
- Retreating blade stall: symptoms and limitations
- Loss of tail rotor effectiveness (LTE
- Blade sailing and ground resonance
- Autorotation: entry and flare technique
- Operational limitations: Vne, weight, CG

Day 9: Advanced Topics and Practical Integration

- Review of key concepts: lift, drag, power, stability
- Composite rotor blades and advanced airfoils
- Tiltrotor and compound helicopter aerodynamics
- Electric propulsion and UAV rotor design
- Flight planning using performance charts
- Case study: cross-country flight performance
- Human factors in helicopter operations
- Safety management and aerodynamic awareness

ASSESSMENT & CERTIFICATION

Delegates are assessed through exercises and a final test. A mark of **50% or above** earns an **AATICD Certificate of Completion**, issued digitally with a unique verification code. This course carries **12 NQF credits** at **NQF Level 5**.

PRICING (PER DELEGATE, EX-VAT)

Delegates	Training Method	Price per Delegate	Total
1	Online	R 35,000.00	**R 35,000.00**
1	In-House	R 45,500.00	**R 45,500.00**
1	On-Campus (Pretoria)	R 52,500.00	**R 52,500.00**

UPCOMING SESSIONS

No sessions are currently scheduled. Please contact us to arrange a session at a time and location that suits your team.

HOW TO GET A QUOTE OR APPLY

1. **Get an instant quotation online:** visit **www.aaticd.co.za**, open the page for this course (Unit Standard 243737) and click **Get A Quote / Apply**. Select your training method and number of delegates — your quotation is generated immediately and emailed to you with the course brochure attached.
2. **Apply by email:** send the course title, your preferred training method (Online, In-House or On-Campus Pretoria), the number of delegates and your preferred dates to **apply@aaticd.co.za** — our team will reply with a formal quotation.
3. **Apply by phone or WhatsApp:** call **+27 12 004 8389** or WhatsApp **+27 65 077 6310** and we will prepare your quotation and reserve your seats.
4. **Confirm your booking:** accept the quotation and settle the invoice. As soon as payment is confirmed your delegates are enrolled and receive their AATICD LMS login details by email, along with joining instructions for their chosen training method.

Group discounts apply automatically — the more delegates you enrol, the lower the price per delegate. No payment is required to request a quotation.

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