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HLK201 HELICOPTER DESIGN

QUESTIONS SET 1

FUNDAMENTALS OF HELICOPTER DESIGN

Q1. (7p) Which component generates lift in a helicopter?

a) Fuselage
b) Tail rotor
c) Main rotor
d) Engine

Q2. (8p) Which cockpit control primarily controls **yaw**?

a) Cyclic
b) Collective
c) Pedals
d) Throttle

Q3. (8p) A helicopter hovers with thrust $T = 10\,000\ N$ and rotor disk area $A = 50\ m^2$. What is the **disk loading**?

$$DL = \frac{T}{A}$$

a) 100 N/m^2
b) 200 N/m^2
c) 500 N/m^2
d) 5 000 N/m^2

Q4. (15p) In hover, the velocity distribution over the rotor disk is:

a) Asymmetric
b) Zero everywhere
c) Symmetric
d) Random

Q5. (8p) What flight regime allows a helicopter to remain stationary relative to the ground?

a) Forward flight
b) Autorotation
c) Hover
d) Axial descent

Q6. (8p) Which power component exists **whenever the rotor rotates**, regardless of forward speed?

a) Induced power
b) Profile power
c) Parasite power
d) Excess power

Q7. (15p) Which statement is **true**?

a) Translational lift exists in hover
b) Hover requires less power than forward flight
c) Hover requires maximum induced power
d) Parasite power dominates in hover

Q8. (8p) Standard air density at sea level is approximately:

a) 1.0 kg/m^3
b) 1.18 kg/m^3
c) 1.225 kg/m^3
d) 1.30 kg/m^3

Q9. (8p) Which rotor configuration **does NOT require a tail rotor**?

a) Single rotor
b) Tandem rotor
c) Conventional helicopter
d) Single-rotor UAV

Q10. (15p) The collective control primarily:

a) Changes rotor RPM
b) Changes blade angle of attack equally
c) Controls yaw
d) Tilts the rotor disk

Q11. (+ 20p - Bonus Question)

A helicopter hovers at sea level with:

- Thrust $T = 40\,000\ N$
- Rotor radius $R = 6\ m \rightarrow A = \pi R^2$
- Air density $\rho = 1.225\ kg/m^3$

Using momentum theory:

$$\vartheta_i = \sqrt{\frac{T}{2\rho A}}, \qquad P_i = T\vartheta_i$$

What are ϑ_i and P_i (approximately)?

a) $\vartheta_i \approx 6.9\ m/s, \quad P_i \approx 276\ kW$

b) $\vartheta_i \approx 8.5\ m/s, \quad P_i \approx 340\ kW$

c) $\vartheta_i \approx 10.2\ m/s, \quad P_i \approx 408\ kW$

d) $\vartheta_i \approx 12.8\ m/s, \quad P_i \approx 512\ kW$