Introduction to Aircraft Design
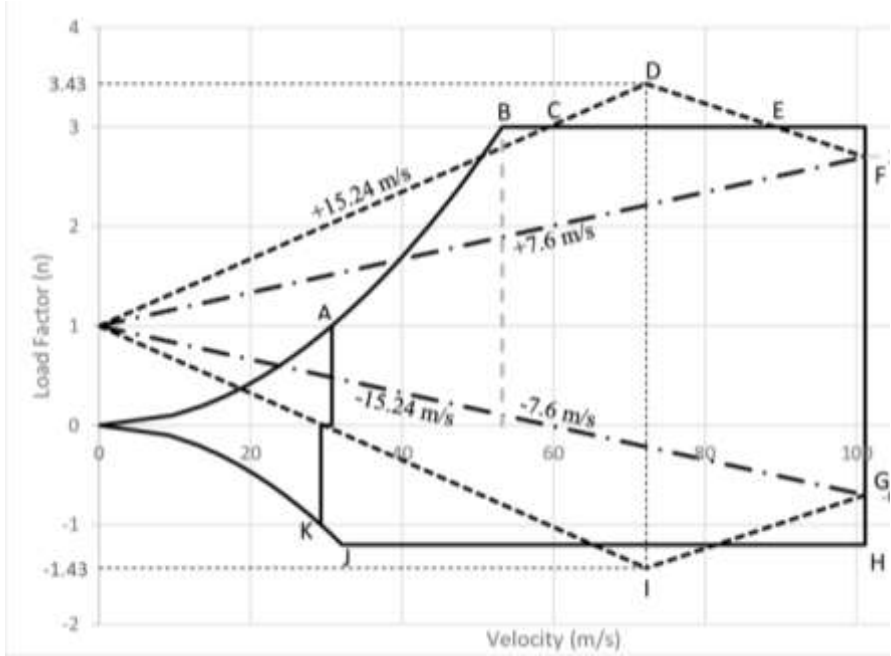# July-2023

Assignment 11

Q 1	Read the following statements and choose the correct option:
	I. Vertical Load Gactor is directly proportional to the square of EAS.
	II. Vertical Load Gactor is inversely proportional to the Angle of Attack.
	III. The V-n diagram is valid only for ISA Sea Level conditions.

MCQ (1 mark)	(A)	All the statements are correct.
	(B)	Only I is correct.
	(C)	Only II is correct.
	(D)	Only III is correct.
	(E)	Only I and II are correct.
	(F)	Only I and III are correct.
	(G)	Only II and III are correct.
	(H)	All the statements are incorrect.

Solution: (B)

Q 2	Which of the following constraint(s) result(s) in an upper limit on Vertical Load Factor?	
MSQ (1 mark)	(A)	Design diving speed
	(B)	Piloting skills
	(C)	Structural strength of the aircraft
	(D)	Safety and comfort of passengers
Solution: (C), (D)		

Q 3	Match the following Aircraft type with the permissible values of typical limit load factor:	
	a) General Aviation-Normal Aircraft i) -1 to 3.8 b) Transport Aircraft ii) -1 to 3 c) Strategic Bomber iii) -6 to 9 d) Fighter iv) -2 to 4	
MSQ (1 mark)	(A)	a) →i)
	(B)	b) →iv)
	(C)	c) →ii)
	(D)	d) →iii)
Solution: (A), (B), (C), (D)		

Q 4	The curve 0B in the V-n diagram represents the limit imposed due to _____.

MCQ (1 mark)	(A)	Stall Angle of Attack
	(B)	Design diving speed
	(C)	Structural strength
	(D)	Powerplant considerations

Solution: (A)

Q 5	Which of the following statement(s) is/are TRUE about Corner Speed?	
MSQ (1 mark)	(A)	It corresponds to the highest possible Load Factor.
	(B)	It corresponds to the Maximum Lift Coefficient.
	(C)	It leads to the fastest turn.
	(D)	It leads to the tightest turn.
Solution: (A), (B), (C), (D)		

Q 6	V-n Diagram as per AP 970 airworthiness requirement, there are cuts at the right top and bottom corner. These cuts are provided due to _____.	
MSQ (1 mark)	(A)	Structural limitations
	(B)	Powerplant limitations
	(C)	Pilot's load bearing capacity
	(D)	Customer requirements
Solution: (B)		

Q 7	Read the following statements and choose the correct option:
	I. The top and bottom limits of the V-n diagram can never be exceeded.
	II. Gust loads can increase the permissible area of V-n diagram.
	III. V-n diagram is valid only for symmetric maneuvers in pitch (xy plane).

MCQ (1 mark)	(A)	All the statements are correct.
	(B)	Only I is correct.
	(C)	Only II is correct.
	(D)	Only III is correct.
	(E)	Only I and II are correct.
	(F)	Only I and III are correct.
	(G)	Only II and III are correct.
	(H)	All the statements are incorrect.

Solution: (G)

Q 8	An aircraft has stall velocity of 30 m/s and has a maximum vertical load factor 4. Estimate its Corner speed (in m/s). (Write your answer correct upto the nearest integer)
NAT (1 mark)	Answer : 60
Solution:	$$V_{corner} = \sqrt{n_{max}} V_{stall} = \sqrt{4} * 30 = 2 * 30 = 60 \, m/s$$

Q 9	Which of the following statement(s) is/are TRUE about Aerodynamic loads?	
MSQ (1 mark)	(A)	They are always symmetrical about the longitudinal axis.
	(B)	They are the only reason for creating distributed loads on aircraft.
	(C)	The Shear loads are much lesser than Pressure loads.
	(D)	Highest pressures are usually encountered at the stagnation point.
Solution: (C), (D)		

Q 10 - 11	An aircraft is in a steady and level flight at 900 kmph operating under ISA Sea level conditions, when it experiences a sharp vertical Gust of 15 m/s. It has a lift curve slope of 0.1 per degrees and wing loading 4000 N/m^2.
Q 10	Calculate the change in the angle of attack due to this Gust. (Write your answers in degrees and correct up to two decimal places)
NAT (1 mark)	Answer : 3.00 - 4.00

Solution:

$$\Delta\alpha = tan^{-1}\left(\frac{Gust\ velocity}{EAS}\right) = tan^{-1}\left(\frac{15}{250}\right) = 3.43\ degrees$$

Q 11	Calculate the change in the vertical load factor due to this Gust. (Write your answer correct upto two decimal places)
NAT (1 mark)	Answer : 3.00 - 3.50

Solution:

Lift curve slope = 0.1*57.3 = 5.73 per radians

$$\Delta N_z = \frac{a_0 * V_{eq} * \rho * V_g}{2 * (W/S)} = \frac{5.73 * 250 * 1.2256 * 15}{2 * 4000} = 3.29$$

Q 12	Which of the following load(s) act(s) as an Airloads?	
MSQ (1 mark)	(A)	Maneuver load
	(B)	Gust load
	(C)	Buffet load
	(D)	Control deflection
Solution: (A), (B), (C), (D)		

Q 13	Read the following statements and choose the correct option: I.Ultimate load is the largest load expected in normal service life. II. Typical value of Factor of Safety is 2.5 in design of aircraft structures. III. Ultimate load is higher than Limit load.	
MCQ (1 mark)	(A)	All the statements are correct.
	(B)	Only I is correct.
	(C)	Only II is correct.
	(D)	Only III is correct.
	(E)	Only I and II are correct.
	(F)	Only I and III are correct.
	(G)	Only II and III are correct.
	(H)	All the statements are incorrect.
Solution: (D)		

Q 14	The additional load factor due to a sharp vertical Gust in steady level flight is directly proportional to the _____.
MSQ (1 mark)	(A) Gust velocity
	(B) Equivalent Airspeed
	(C) aircraft weight
	(D) wing reference area
	(E) Thrust loading
	(F) True Airspeed
	(G) aircraft lift curve slope
	(H) density at cruising altitude
Solution: (A), (B), (D), (G), (H)	

Q 15	What is/are the unique feature(s) of Global Hawk HALE UAV?
MSQ (1 mark)	(A) It has High Aspect Ratio wings.
	(B) It has Solar Panels all over its wings.
	(C) It has a nose shape like a Beluga whale.
	(D) It is powered by a single turbofan engine.
	(E) It has a butterfly tail.
	(F) It has an endurance of more than 30 hours.
Solution: (A), (C), (D), (E), (F)	