Introduction to Aircraft Design
July-2023

Assignment 4

Q 1	Which of the following statement(s) is/are TRUE about Nosewheel type landing gears?	
MSQ (1 mark)	(A)	It provides low Drag during take-off run.
	(B)	It results in STOL capability.
	(C)	It provides a good view for cockpit crew while on the runway.
	(D)	It provides large Angle of Attack during ground run.
Solution: (A), (C)		

Q 2	Which of the following statement(s) is/are TRUE about *Lockheed Martin F-22 Raptor*?	
MSQ (1 mark)	(A)	It is a two seater, twin engined aircraft.
	(B)	It is an all-weather tactical Stealth fighter aircraft.
	(C)	It is a sixth-generation fighter aircraft.
	(D)	It has leading edge root extensions in the wing.
	(E)	It can fly up to an altitude of 20 km AMSL.
	(F)	It can fly supersonic without using Afterburner.
	(G)	It has a Thrust-to-Weight ratio ≥ 1.0 with an Afterburner.
Solution: (B), (D), (E), (F), (G)		

Q 3	Which of the following feature(s) is/are desirable for Advanced Tactical Fighter aircraft?	
MSQ (1 mark)	(A)	Air superiority
	(B)	High wing loading
	(C)	Low radar signature
	(D)	Use of composites
Solution: (A), (B), (C), (D)		

Q 4	Read the following statements and choose the correct option: I. The distance between the wing tips is called as the Chord of the wing. II. Wing reference area is the planform area of the wing in Top view, excluding the area inside the fuselage. III. Taper Ratio is zero for a rectangular wing.	
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)	Both I and II are correct.
	(F)	Both I and III are correct.
	(G)	Both II and III are correct.
	(H)	All the statements are incorrect.
Solution: (H)		

Q 5-7	An aircraft has a leading edge sweep of 15 degrees with an unswept trailing edge. It has a wingspan of 20 m and a root chord of 5 m.
Q 5	Calculate the Taper Ratio of the wing. (Write your answer correct upto two decimal places)
NAT (1 mark)	Answer : 0.42 - 0.48
Solution: Using trapezoid geometry, first calculate the tip chord. Tip chord will be 2.32 m Then Taper Ratio will be 2.32/5 = 0.46	
Q 6	Calculate the Aspect Ratio of the wing. (Write your answer correct upto two decimal places)
NAT (1 mark)	Answer : 5.42 - 5.50
Solution: Calculate the Area using trapezoid geometry: Wing reference area = 73.2 m^2 Wingspan = 20 m Wing Aspect Ratio, AR= $\frac{b^2}{S} = \frac{20^2}{73.2} = 5.46$	
Q 7	Calculate the Mean Aerodynamic Chord of this wing. (Write your answer correct upto two decimal places)
NAT (1 mark)	Answer : 3.75 - 3.85

Solution:

Mean Aerodynamic Chord,

$$\overline{C} = \frac{2}{3} C_r \left(\frac{1+\lambda+\lambda^2}{1+\lambda} \right) = \frac{2}{3} * 5 * \left(\frac{1+0.46+0.46^2}{1+0.46} \right) = 3.81$$

Q 8	Which of the following wing geometry parameter(s) affect(s) its aerodynamics?	
MSQ (1 mark)	(A)	Airfoil Camber
	(B)	Airfoil Thickness Ratio
	(C)	Aspect Ratio
	(D)	Taper Ratio
	(E)	Leading edge sweep angle
Solution: (A), (B), (C), (D), (E)		

Q 9	Read the following statements and choose the correct option: I. A high Aspect Ratio wing is desirable for long endurance aircraft. II. A tapered wing is always heavier than the rectangular wing of same wingspan. III. Increase in wing thickness ratio always leads to a heavier wing.	
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)	Both I and II are correct.
	(F)	Both I and III are correct.
	(G)	Both II and III are correct.
	(H)	All the statements are incorrect.
Solution: (B)		

Q 10	Which of the following statement(s) is/are TRUE about the High wing layout?	
MSQ (1 mark)	(A)	It is desirable for heavy cargo aircraft.
	(B)	It is easy to assemble on the fuselage.
	(C)	It requires blisters on the fuselage to accommodate the landing gears.
	(D)	It suffers from poor visibility during turning and climbing flight.
Solution: (A), (B), (C), (D)		

Q 11	Which of the following statement(s) is/are TRUE about the Low wing layout?	
MSQ (1 mark)	(A)	It is desirable for a large passenger transport aircraft.
	(B)	It has high structural mass.
	(C)	It has a lower Ground Effect.
	(D)	It has a better rough field performance.
Solution: (A)		

Q 12	Which of the following aircraft has/have the Mid wing layout?	
MSQ (1 mark)	(A)	*IAI Westwind*
	(B)	*Supermarine Spitfire*
	(C)	*Cessna 182 Skylane*
	(D)	*HFB 320 Hansa Jet*
	(E)	*MiG 27 Flogger*
	(F)	*SEPECAT Jaguar*
	(G)	*MiG 21 Fishbed*
Solution: (A), (D), (G)		

Q 13	Read the following statements and choose the correct option: I. A Tractor configuration is stable and easier to control. II. A Pusher configuration has improved pilot visibility. III. A Pusher configuration has higher propeller efficiency.	
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)	Both I and II are correct.
	(F)	Both I and III are correct.
	(G)	Both II and III are correct.
	(H)	All the statements are incorrect.
Solution: (E)		

Q 14	Which of the following statement(s) is/are TRUE about vertical tail of an aircraft?	
MSQ (1 mark)	(A)	It provides stability in yawing motion.
	(B)	It is required to trim the aircraft in case of Engine failure.
	(C)	It is present in all military aircraft.
	(D)	It provides sufficient moments to overcome *spin recovery.*
Solution: (A), (B), (D)		

Q 15	Which of the following statement(s) is/are TRUE about V-tail, compared to a conventional tail?	
MSQ (1 mark)	(A)	It has lower structural weight.
	(B)	It has lower complexity.
	(C)	It has higher Interference Drag.
	(D)	It is desirable for ab-initio Trainer aircraft.
Solution: (A)		