

FDS(EWAC 01)

Principles of flight

Attempt all question in part A and any three from from part B

PART A

1. In which situation would the wing lift of an aircraft in straight and level flight have the highest value?

- a. Forward Centre of gravity and idle thrust
- b. Forward center of gravity and take-off thrust
- c. Aft Centre of gravity and take-off thrust
- d. Aft Centre of gravity and idle thrust

2. The lift and drag forces,generated by a wing –cross section?

- a. Are determined by the pressure distribution about the wing cross section
- b. Are normal to each other at one angle of attack
- c. Are proportional to each other regardless of changes in angle of attack
- d. Vary lineary with the angle of attack

3. A pitot tube facing into the air stream will measure a pressure equal to:

- a. static pressure
- b. dynamic pressure
- c. dynamic plus static pressure
- d. dynamic minus static

4 An aircraft enters a horizontal turn with a load factor $n = 2$ from the straight and level flight whilst maintaining constant indicated air speed. The?

- a. total drag becomes four times its original value.
- b. lift doubles
- c. lift becomes four times its original value
- d induced drag doubles

5. a flat plate ,when placed in the airflow at a small angle of attack ,will produce ?

- a. neither lift nor drag
- b. both lift and drag
- c. lift but no drag
- d. drag but no lift

6. ***an aircraft flies in straight and level flight with a lift coefficient $CL=1$ What will be the new value of CL after the speed has doubled, whilst still maintaining the original condition of flight?***
- 0.50
 - 1.00
 - 2.00
 - 0.25
7. ***assuming zero wing twist ,the wing plan form that gives the highest local lift coefficient at the wing root is ?***
- Rectangular
 - Swept back
 - Elliptical
 - Tapered
8. ***In a stationery subsonic streamline flow pattern, if streamline converge,inthis part of the pattern, the static pressure(I) will....and the velocity(II) Will...:***
- (i)decrease (ii)increase
 - Increase (ii) increase
 - Increase(ii)decrease
 - Decrease (ii)decrease**
9. ***minimum drag of an aircraft in straight and level flight occurs at the?***
- Minimum speed
 - Minimum CD value
 - Maximum $CL-CD$ ratio
 - Minimum angle of attack
10. ***A wing has a span of 50ft and an area of 200sq ft, its mean chord is:***
- 2.5ft
 - 4ft
 - 10ft
11. ***increasing dynamic pressure will have the following effect on the drag of an aircraft(all other factors of importance remaining constant)?***
- None
 - Drag decreases across the whole speed range
 - Drag increases across the whole speed range
 - At speed greater than minimum drag ,drag increases
12. ***Directional control is provided by:***
- The rudder
 - The elevators
 - The ailerons
13. ***Wing loading is:***
- The ratio of lift to aircraft
 - The ratio of wing weight to wing area
 - The ratio of total aircraft weight to wing area

14. which one of the following statements about Bernoulli's theorem is correct

- a. The dynamic pressure is maximum in stagnation point]
- b. The pressure decreases as static pressure decreases
- c. The total pressure is zero when the velocity of the stream is zero
- d. The dynamic pressure increases as static pressure decreases

15. in a two dimensional flow pattern ,where the streamline converge the static pressure will be:

- a. not change
- b. increase
- c. decrease
- d. increase initially, then decrease

16. The taper ratio is:

- a. the ratio of root incidence to tip incidence
- b. the ratio of root thickness to tip thickness
- c. the ratio of tip chord length to root chord length
- d. ratio of dihedral angle to root chord length

17. yaw control is provided by:

- a. elevators
- b. rudder
- c. ailerons
- d. flaps

18. The total pressure is :

- a. Static pressure minus the dynamic pressure
- b. Static pressure plus the dynamic pressure
- c. $\frac{1}{2}\rho v^2$
- d. Can be measured in small hole in a surface , parallel to the local stream

19. Rolling is movement about:

- a. Longitudinal axis
- b. Normal axis
- c. Lateral axis

20. the boundary layer of a wing is?

- a. caused by suction on the upper wing surface
- b. a layer on the wing in which the stream velocity is lower than the free stream velocity.
- c. Created by the normal shock wave at transonic speed
- d. A turbulent flow around the wing

21. the aircraft drag in straight and level flight is lowest when the :When the aircraft is in straight and level flight the normal axis is:

- a. Induced drag in straight and level flight is lowest

- b. Parasite drag equals twice the induced drag
- c. Parasite drag is equal to the induced drag
- d. Induced drag is equal to zero

**22. Which of the following statement, about a venturi in a sub –sonic airflow are correct?
1. the dynamic pressure in the undisturbed flow and in the throat are equal. 2. The total pressure in the undisturbed flow and the in the throat are equal**

- a. 1 is incorrect and 2 is correct
- b. 1 and 2 are correct
- c. 1 is correct and 2 is incorrect
- d. 1 and 2 are incorrect

23. The continuity equation states: if the area of the tube is increasing, the speed of the subsonic and incompressible flow inside is/

- a. Sonic
- b. Not changing
- c. Increasing
- d. Decreasing

24. a high aspect ratio wing produces:

- a. A decrease in stall speed
- b. Less sensitivity to gust effect
- c. A decrease in induced drag
- d. An increase in induced drag

25. The correct drag formula is:

- a. $D = \frac{1}{2} \rho v^2 S c_d$
- b. $D = c_d 2 \rho v^2 s$
- c. $D = c_d \frac{1}{2} \rho v s$
- d. $D = C_D \frac{1}{2} \rho v^2 S$

26. the value of the induced drag of an aircraft in straight and level flight at a constant weight varies linearly with::

- a. V
- b. $1/V^2$
- c. V^2
- d. $1/V$

28. The angle of attack of an aerofoil is the angle between the:

- a. Chord line and the relative un disturbed airflow
- b. Bottom surface and the horizontal
- c. Bottom surface and the relative air flow

d. *Bottom surface and the chord line*

29. The angle between the aircraft longitudinal axis and the chord line the:

- a. Angle of attack
- b. Glide path angle
- c. Angle of incidence
- d. Climb path angle

30. The Mach number:

- a. *Increases at a given TAS ,When the temperature rises*
- b. *Is the ratio between the TAS of the aero plane and the speed of sound at sea level*
- c. *Is the between the IAS of the aircraft and the local speed of sound*
- d. *Is the ration between the TAS of the aircraft and tye the local speed of sound*

31. How does temperature influence the speed of sound?

- a. *Speed of sound increases with temperature increase*
- b. *Speed of sound decreases with temperature increase*
- c. *Speed of sound is not influenced by temperature*
- d. *speed of sound remains constant*

32. The speed of sound is affected by the :

- a. *pressure of the air*
- b. *density of the air*
- c. *temperature of the air*
- d. *humidity of the air*

33. The regime of flight from the critical Mach number up to $M=1.3$ is called the

- a. *hypersonic range*
- b. *supersonic range*
- c. *transonic range*
- d. *subsonic range*

34. If temperatures in a gas is kept constant and pressure increases, the density.

- a. *Increases*
- b. *Decreases*
- c. *Remains constant*
- d. *Don't know*

35. The wing area divided by the span of a wing is called;

- a. *Mean chord*
- b. *Fineness ratio*
- c. *Wash out*
- d. *Aspect ratio*

36 A line drawn from the leading edge to the trailing edge of the airfoil and equidistant at all points from the upper and lower contours is called the

- a. *Chord line*

- b. Mean chord
- c. Mean curvatures line
- d. Mean camber

37. The angle between the chord line of the wing and the longitudinal axis of airplane is known as the angle of

- a. Attack
- b. Relative wind
- c. Incidence
- d. Dihedral

38. Aspect ratio of a wing is defined as the ratio of the

- a. Wing span to the wing root
- b. Square of the chord to the wingspan
- c. Square of the wing span to the wing area
- d. Wing span to the main compressed rib

39. The resistance, or skin friction, due to the viscosity of the air as it passes along the surface of the wing is part of

- a. Induced drag
- b. Form drag
- c. Parasite drag
- d. Interference drag

40. The angle between the chord line of an airfoil and the relative wind is known as

- a. Attack
- b. Lift
- c. Incidence
- d. Longitudinal dihedral

41. If pressure is kept constant and temperature increases, the density

- a. Increase
- b. Decreases
- c. Remain constant
- d. No idea

42. If density is kept constant, the dynamic pressure increases proportionally with

- a. Velocity
- b. The square of velocity
- c. The static pressure
- d. Inversely with the square of velocity

43. If the velocity and angle of attack is kept constant and density decreases the lift will

- a. increases

- b. decreases
- c. remains constant
- d. density has no effect

44. a high aspect ratio wing

- a. decreases skin friction drag
- b. decrease induced drag
- c. increases induced drag
- d. increases parasite drag

45. The lateral axis is also called, the ,

- a. Pitch axis
- b. Normal axis
- c. Roll axis
- d. Horizontal axis

46. The stalling angle of attack of a typical aerofoil is approximately:

- a. 4°
- b. 10°
- c. 15°
- d. 25°

47. if density of air is increased, the lift will:

- a. Remain constant
- b. Decrease
- c. Increase
- d. Decrease then increase

48. .As it applies to airfoils, which statement is in agreement with Bernoulli's principle?

- a. The speed of a fluid increases at points where the static pressure of the fluid increases
- b. The static pressure of a fluid decreases at points where the speed of the fluid increases
- c. Static pressure of fluid increases at points where the speed of fluid increases
- d. The static pressure of a fluid decreases at points where the speed of the fluid decreases

49. If the density of air is increased, the lift will:

- a. Remain constant
- b. Decrease
- c. Increase
- d. No idea

50. to maintain a steady level flight, as the angle of attack is increased the airspeed must be :

- a. Increased
- b. Decreased
- c. Held constant

PART 2

1. Define the following terms

- a. Aspect ratio
- b. Wash out
- c. Wash in
- d. Load factor
- e. Fineness ratio
- f. Taper ratio

(6mks)

2. Compute the aircraft LIFT required for an aircraft given the following parameters

Aircraft mass: 60000kg

Velocity 300kts

Wing area: 200 square meters

Coefficient of Lift: 0.080

Density of Air: 1.225 kg/m³

(6 Mks)

3. a. Illustrate the three main axis in relation to Flight Control, state the Flight Control Device responsible for each.

6Mks

b. Explain TWO factors that affect DRAG.

2Marks