

Register Number:

B. E DEGREE EXAMINATIONS: NOV / DEC 2012

Fifth Semester

AERONAUTICAL ENGINEERING

AER108: Aerodynamics II

Time: Three Hours

Maximum Marks: 100

Answer ALL Questions:-

PART A (10 x 1 = 10 Marks)

1. Compressibility effect is
 - a) drag associated with the form of an aircraft
 - b) drag associated with the friction of the air over the surface of the aircraft
 - c) the increase in total drag of an aerofoil in transonic flight due to the formation of shock waves
 - d) None of the above
2. The speed of sound in the atmosphere
 - a) varies according to the frequency of the sound
 - b) changes with a change in temperature
 - c) changes with a change in pressure
 - d) All of the above
3. The airflow behind a normal shockwave will
 - a) always be subsonic and in the same direction as the original airflow
 - b) always be supersonic and in the same direction as the original airflow
 - c) always be subsonic and deflected from the direction of the original airflow
 - d) both (a) & (b)
4. Bernoulli's equation shows that
 - a) at constant velocity the kinetic energy of the air changes with a change of height
 - b) with a change in speed at constant height both kinetic and potential energies change
 - c) with a change in velocity at constant height the static pressure will change
 - d) None of the above
5. Mach angle can be expressed as

a) $\mu = \sin^{-1} M$ b) $\mu = \sin^{-1} \left(\frac{1}{M} \right)$ c) $\mu = \sin^{-1} \left(\frac{1}{M^2} \right)$ d) $\mu = \sin^{-1}(1+M^2)$

6. When $\theta < \theta_{\max}$, each value of θ and M having two different wave angles β , The larger value of β is called
- a) strong shock solution b) weak shock solution c) shock polar d) None of the above
7. Passage used to transform pressure energy into kinetic energy is
- a) Honey comb b) Nozzle c) cone d) All of the above
8. In a convergent ducts during supersonic flow, the velocity
- a) remains constant b) increases c) decreases d) both (b) & (c)
9. The mach number in which free stream velocity equal to 340 m/s somewhere on the boundary is called
- a) free stream mach number b) critical mach number
c) none of the above d) both (a) & (b)
10. The lift/drag ratio is
- a) higher at mach numbers above supersonic b) higher at sub sonic mach numbers
c) both (a) & (b) d) None of the above

PART B (10 x 2 = 20 Marks)

11. Differentiate between compressible flow and incompressible flow.
12. Calculate the mach number of an airplane flying at 9 km altitude with the velocity of 220 m/s.
13. Write the Bernoulli's equation for incompressible flow.
14. Write the adiabatic relation between temperature, pressure and density.
15. Define shock tube?
16. Write a note on detached shock?
17. Discuss about D Laval Nozzle.
18. Brief about chocked flow.
19. Define Drag divergence mach number.
20. Write notes on tip effects.

PART C (5 x 14 = 70 Marks)

21. a) Define the compressibility of air as a medium in aerodynamics. Establish the lowest Mach number at which it starts showing its presence. Show that the pressure Coefficient C_p at Mach number is different from that in an incompressible flow. Can you show it by another method? Make use of sketches and plots.

(OR)

- b) What is the relationship between internal energy and enthalpy? Carbon dioxide expands isentropically through a nozzle from a pressure of 3.0 bar to 1.0 bar. If the initial temperature is 463 K, determine
- (i) The final temperature,
 - (ii) The enthalpy drop and
 - (iii) The change in the internal energy.

22. a) Derive the Hugoniot equation and explain the Hugoniot Curve.

(OR)

- b) (i) Derive the equation of motion for a Normal shock wave.
(ii) Derive the Prandtl's Normal Shock relation for a Perfect gas.

23. a) A supersonic flow with $M_1 = 2.0$, $p_1 = 1$ atm, and $T_1 = 520$ K is expanded around a sharp corner through a deflection angle of 23.380° . Calculate M_2 , p_2 , T_2 , p_{02} , T_{02} and the angles that the forward and rearward Mach lines make with respect to the upstream flow.

(OR)

- b) Write short notes on
- (i) Supersonic flow over a wedge
 - (ii) Weak Oblique shocks
 - (iii) Supersonic Compression
 - (iv) Supersonic Expansion by Turning

24. a) What do you understand by one dimensional flow? Derive momentum equation for quasi-one-dimensional flow.

(OR)

- b) A Pitot tube was inserted into an airflow where the static pressure is 1atm. Calculate the flow Mach number when the Pitot tube measures
- (a) 1.276 atm (b) 2.714 atm
 - (c) 12.06 atm. (d) Derive the Rayleigh's Pitot tube formula used

25. a) Briefly explain the effects of thickness, camber and aspect ratio over the performance of wings in high speed flows.

(OR)

- b) (i) Briefly explain the need and characteristic features of Transonic area rule.
(ii) Briefly explain the characteristics features of swept wings.
