SATHYABAMA UNIVERSITY

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Course & Branch: B.E – Aeronautical
Title of the paper: Aerodynamics - II
Semester: V — Max.Marks: 80
Sub.Code: 526502-626501 — Time: 3 Hours
Date: 20-04-2009 — Session: AN

PART – A (10 x 2 = 20)

Answer All the Questions

1. What is a De Laval nozzle and state the function of the same.
2. What are stagnation conditions?
3. What is a shock wave?
4. Define oblique shock wave.
5. State small Perturbation theory.
6. What is meant by Prandtl Glauert transformation?
7. What is lower and upper critical Mach number?
8. Name the characteristics of swept wings.
9. What are the main points to be considered while designing the tunnel layouts?
10. What is a shock tube?

PART – B (5 x 12 = 60)

Answer All the Questions

11. Derive the relation between pressure and temperature at inlet and outlet for compressible fluids.

$$P_2 / P_1 = (T_2 / T_1)^{\gamma / \gamma-1}$$

(or)

12. A De Laval nozzle has to be designed for an exit Mach number of 1.5 with exit diameter of 200 mm. Find the ration of throat area to exit area necessary. The reservoir conditions are given as:
P_o = 1 atm. (gauge) T_o = 20° c
Find also the maximum flow rate through the nozzle. What will be the exit pressure and temperature.

13. A normal shock wave moves at a constant speed of 500 m/s into still air at 0° c and 0.7 atm. Determine the static and stagnation conditions present in the air after the passage of wave.

(or)

14. Air flows above a frictionless surface having a sharp corner. The flow angles and mach number in downstream from the corner are -60° and 4.0 respectively. Calculate the upstream Mach number for flow angle of 15° clockwise and 15° counter clockwise.

15. A missile has a conical nose with a semi vertex angle of 4° and is subjected to a Mach number of 12 under actual conditions. A model of the missile has to be tested in a supersonic wind tunnel at a test section Mach number of 2.5. calculate the semi vertex angle of the conical nose of the model.

(or)

16. The upper and lower surfaces of a symmetrical 2-D aerofoil are given by $Z = \pm \epsilon\chi\,(1-\chi/c)^2$ where c is the chord and $\epsilon << 1$. The aerofoil is at zero distance in a steady supersonic stream of Mach number M_α in the positive χ direction.

    (a) Find the velocity components according to the linear theory in the upper region of disturbance.

    (b) Show that the drag coefficient of the aerofoil is given by

$$Cd = \frac{8}{15}\varepsilon^2 \frac{\varepsilon^2}{(M_\infty^2 - 1)^{1/2}}$$

17. (a) What is transonic region (2)

    (b) Derive the equation for transonic flow (10)

(or)

18. Explain the effects of thickness, camber and aspect ration of wings.

19. What are the various tunnel layouts and explain with design features?

(or)

20. What are the flow visualization methods and explain optical methods.