No. of Printed Pages : 4 **BAS-015**

B.TECH. IN AEROSPACE ENGINEERING (BTAE)

00955

Term-End Examination

June, 2012

BAS-015 : Aerodynamics - II

Time : 3 Hours *Maximum Marks : 70*

Note : *(1) Question No. 1 is **compulsory.***

*(2) Attempt **any six** from question No. 2 - 9.*

Attempt ***any five*** of the following : **5x2=10**

1. (a) Write the one - dimensional energy and momentum equations for an adiabatic compressible steady flow.

(b) Define De Laval Nozzle. Also describe with figure an under - expanded Nozzle.

(c) Why a Golf ball is dimpled ?

(d) What is Helmholtz's theorem ?

(e) An air plane is flying at 3.0 Mach at an altitude where the pressure and temperature are respectively 0.5 atm and $-20°C$. Calculate the pressure and temperature at the leading edge of the wing.

(f) Air flows through a rough constant area pipe with inside diameter 0.12 m. The inlet flow conditions are $M_1 = 0.44$ and $P_1 = 1 atm$. Assuming friction constant $f = 0.005$, calculate the minimum length of pipe required to make the flow sonic. Also calculate pressure at exit.

2. (a) Derive relationship for the ratio of stagnation pressure to static pressure and Mach number for an isentropic flow. Derive similar relations for temperature and density ratios. 5

(b) Air flows isentropically through a divergent passage of inlet area 7 cm^2. If inlet conditions are $M_1 = 1.4$, $P_1 = 1$atm, $T_1 = 27°$ C, and exit Mach No. $M_2 = 3.0$. Compute 1+2+2

(i) the mass flow rate

(ii) exit pressure and

(iii) exit Area

3. (a) A thin plate of length 2 m and width 1m is moving in air along it's length at a speed of 10 m/s. Calculate the total skin friction drag on the plate assuming seal level conditions. 7

(b) Write a short note on Laminar flow airfoils 3

4. (a) Derive the fundamental equation of the Prandtl's lifting line theory. 4

(b) Show that for an elliptical lift distribution, induced drag coefficient, $C_{Di} = C_L^2/\pi AR$, where C_L is lift coefficient and AR is aspect ratio of wing. 6

5. (a) Sketch the shock polar for $M = 3.0$ depicting Mach Nos, for no flow deplection and θ_{max}. Explain the method of finding the Mach no. 5. and shock angles for a turning angle of 5 degree 6

(b) Write a short note on Expansion Hodograph 4

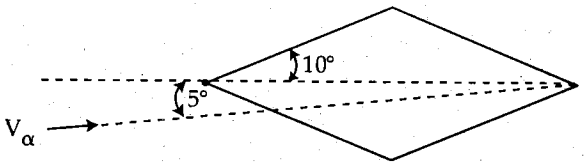
6. (a) Draw a Mollier diagram for flow through a constant area duct with heat addition. 4

(b) Air enters a constant area duct of length 2 m at $M_1 = 0.2$, $P_1 = 1$ atm and $T_1 = 273K$. Inside the duct, the heat added per unit mass per unit length is $5 \times 10^5 Jkg/m$. Calculate the flow properties M_2, P_2, T_2, P_{02}, T_{02}, and P_2 at exit. 6

7. (a) Explain with diagram, the features and method of swinging a cricket ball. 5

(b) Write a note on boundary layer separation. How it is different for laminar and turbulent flows ? 5

8. Consider a double wedge air foil having chord $C = 2m$ and half angle 10° kept at an angle of attack of 5° in supersonic stream of Mach number 2.5. Evaluate lift and Drag of this airfoil considering sea level conditions 10



9. (a) Derive an expression connecting area and velocity variations with Mach number for a one dimensional compressible flow. 6

(b) Sketch the variation of Mach number, pressure ratio P/P_0 and Temperature ratio T/T_0 along a De - Laval nozzle for an Isen tropic flow. Mark the Important values. 4