No. of Printed Pages : **4**

BAS-015

00860

B.TECH. (AEROSPACE ENGINEERING) (BTAE)

Term-End Examination

June, 2013

BAS-015 : AERODYNAMICS - II

Time : 3 Hours *Maximum Marks : 70*

*Note : Question No. **one** is **compulsory**. Attempt any six question from the remaining questions Q. 2 to Q. 9. Use of Gas Table is permitted.*

1. Fill in the blank : 2x5=10

   (a) Down wash is _____ over the span of a finite wing for an elliptical lift distribution.

   (b) In choking condition massflow rate at the throat of the C-D nozzle is _____.

   (c) When turning angle of the flow is more than the maximum turning angle ($\theta > \theta_{max}$) then shock becomes _____ to the surface.

   (d) _____ point at which the velocity gradient becomes zero.

   (e) Downstream Mach No behind the oblique shock wave is _____ than the upstream Mach No.

2. (a) Derive an expression for induced drag coefficient and induced angle of attack of a finite wing for elliptical lift distribution. **7+3=10**

(b) Differentiate between finite and infinite wing with suitable sketch and plot.

3. (a) Explain Prandtl Lifting line theory with suitable sketch. **6+4=10**

(b) The measured lift slope for the NACA 23012 is 0.1080 degree^{-1} and $\alpha_{L=0} = -1.3°$. Consider a finite wing using this air foil with AR = 8 and taper ratio = 0.8. Assume that $\delta = \tau = 0.055$ calculate the lift and induced drag.

Coefficient for this wing at a geometrical angle of attack = 7°.

4. Show with suitable derivation that flow behind the normal shock is always subsonic. **10**

5. Consider a normal shock wave and demonstrate that Mach No M_2 given in terms of free stream Mach No M_1 is : **10**

$$M_2^2 = \frac{2 + (r-1)M_1^2}{2r M_1^2 - (r-1)}$$

6. (a) Derive an expression for area ratio between inlet and throat and Mach No of C-D Nozzle **5+5=10**

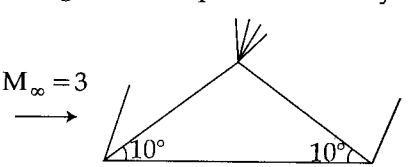
$$\frac{A}{A^*} = \frac{1}{M_1}\left[\frac{2}{r+1} + \frac{r-1}{r+1} M_1^2\right]^{\frac{r+1}{2(r-1)}}$$

(b) A uniform supersonic flow at $M_1 = 2.0$, $P_1 = 0.85 \times 10^5$ N/m^2 and temperature $= 270°K$ expands through two convex corner of 10° each. Determine the Downstream Mach No M_3, P_2, T_2 and angle of the second fan.

7. (a) Explain in brief the theory of detached shock wave in front of a blunt body. **5+5=10**

(b) A uniform supersonic airflow at Mach No = 2.0 passes over a wedge. An oblique shock making an angle 40° with the flow direction is attached to the wedge. If the static pressure and temperature in the free stream are 0.5×10^5 N/m^2 and 0°C respectively, determine the static pressure and temperature behind the wave, Mach No of the flow passing over the wedge and wedge angle.

8. (a) A two-dimensional wedge moves through the atmosphere at sea level at zero angle of attack with $M_\infty = 3.0$. Calculate C_L and C_D using shock expansion theory. **7+3=10**



(b) Why Dimples are manufactured on the surface of Golf ball ? Explain in brief.

9. (a) A roughened thin board 25 cm wide, 200 cm long moves at 3 m/s through water. The boundary layer is 5 cm thick both sides at rear end of the board, and the velocity distribution is prescribed by the relation **5+5=10**

$$\frac{u}{v_0} = \left(\frac{y}{\delta}\right)^{1/4}$$

Find drag force in Newtons and express it as a pure number independent of thickness δ.

(b) Explain phenomena of flow separation over the flat surface. Justify why separation of turbulent boundary layer does not occur easily compare to laminar boundary layer ?