No. of Printed Pages : 3

BAS-015

B.TECH. (AEROSPACE ENGINEERING) (BTAE)

Term-End Examination

December, 2012

BAS-015 : AERODYNAMICS - II

01503

Time : 3 Hours *Maximum Marks : 70*

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

(2) Attempt ***any 6*** *from question No.* ***2 - 9.***

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

(a) Explain the formation of wing-tip vortices.

(b) What is a detached shock wave ? When is it formed ?

(c) How laminar flow airfoil geometry is different from a conventional airfoil ?

(d) An 'airplane' 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.

(e) Sketch the variation of Pressure ratio $P/P_{o'}$ with important values, along a De-laval nozzle for supersonic isentropic flow.

(f) Bring out any two important differences between shock waves and expansion waves in a supersonic flow.

2. (a) Derive a relationship for speed of sound in air. 5

(b) Air flows isentropically through a convergent passage of inlet area 10 cm^2. If inlet conditions are $M_1 = 0.2$, $P_1 = 1$ atm, $T_1 = 27°C$, and exit Mach No. $M_2 = 0.8$. 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 1 m is moving in air along its length at a speed of 10 m/s. Calculate the total skin friction drag on the plate assuming sea level conditions. 7

(b) Write short note on Boundary Layer Separation. 3

4. (a) What is Helmholtz's theorem ? 2

(b) Derive the fundamental equation of the prandtl's lifting line theory. 4

(c) Show that for an elliptical lift distribution the downwash is constant over the span of the wing. 4

5. (a) Plot a relation connecting flow turning angle (θ), shock angle (β) and free stream Mach number (M) for oblique shock waves. Explain the key features of this plot. 7

(b) Write a short note on Expansion Hodograph. 3

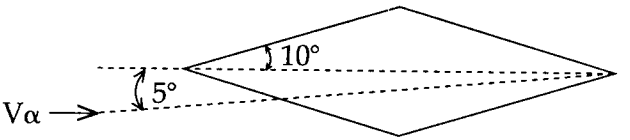
6. (a) Draw a Mollier diagram for flow through a rough constant area duet. 4

(b) Air enters a rough constant area duct of length 30 m and Diameter 0.15 m at $M_1 = 0.3$, $P_1 = 1$ atm and $T_1 = 273$ K assuming friction constant $f = 0.005$, calculate the flow properties M_2, P_2, T_2, P_{O2}, T_{O2} and P_2 at exit. 6

7. (a) Sketch the flow pattern past spherical at different Reynold nos. with respect to sequence of events like vortex shedding, Laminar Separation and Turbulent Separation. 8

(b) Why a golf ball is dimpled ? 2

8. Consider a double wedge airfoil having chord $C = 2$ m 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) Explain briefly the procedure to be followed for analysis of a supersonic nozzle using method of characteristics. 7

(b) Write notes on optimum, under-expanded and over-expanded C-D nozzles. 3