No. of Printed Pages : 3

BAS-015

B.Tech. AEROSPACE ENGINEERING (BTAE)

00358 **Term-End Examination**

June, 2016

BAS-015 : AERODYNAMICS – II

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any* ***seven*** *questions. All questions carry equal marks. Use of scientific calculator is permitted.*

1. (a) Explain the concept of Prandtl-Meyer expansion around a convex corner and represent it in Hodograph plane. *6*

(b) A supersonic flow at $M_1 = 1{\cdot}58$ and $P_1 = 1$ atm, expands around a sharp corner. If the pressure downstream of the corner is 0·1306 atm, calculate the deflection angle of the corner. *4*

2. (a) What are the different regions of compressible flow ? What is isentropic flow with variable area ? Explain. *6*

(b) An aeroplane travels at a speed of 1600 kmph at an altitude, where the pressure and temperature are 40 kPa and –35°C. Find the Mach angle and Mach number. *4*

3. (a) Sketch the pressure variation along the centre line of a converging-diverging nozzle for optimum expansion. What is the influence of back pressure on this variation ? Discuss in brief. 5

(b) What conditions favour the detachment of shock waves in supersonic flows over solid bodies ? Explain why shocks cannot occur in subsonic flows. 5

4. Answer any ***four*** of the following questions in brief : $4 \times 2\frac{1}{2} = 10$

(a) What is boundary layer thickness ?

(b) Relate vorticity to circulation.

(c) Define Prandtl lifting line theory.

(d) Explain Mach number spectrum.

(e) What is expansion hodograph ?

(f) How is horse shoe vortex formed ?

5. (a) Describe the behaviour of a swept wing of an aircraft placed in a supersonic flow. 5

(b) Describe the singularity distribution method to predict the flow over a three-dimensional body in supersonic flow. 5

6. (a) Obtain an expression for velocity of sound in terms of specific heats and local temperature in air medium from one-dimensional continuity, momentum and energy equations. 6

(b) What is the maximum possible turning angle when a supersonic stream flows over an expansion corner ? Give reasons. 4

7. Using suitable assumptions, derive the linearised velocity potential equation for compressible flows past an airfoil and find out the pressure coefficient. What are the boundary conditions imposed to solve the problem numerically ? *10*

8. (a) Draw h-s diagram for the flow through a nozzle. Show how the stagnation properties get affected. *6*

   (b) A plane travels at a speed of 2400 kmph in an atmosphere of $-30°C$. Find the Mach angle. *4*

9. Analyse the performance characteristics of a convergent-divergent nozzle for different inlet and outlet conditions. *10*