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BAS-015

B.TECH. IN AEROSPACE ENGINEERING (BTAE)

00082

Term-End Examination

December, 2011

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) What is meant by Mach Cone ? **2**

   (b) A C-D Nozzle has to be designed for an exit Mach number of 1.5 with exit diameter of 200 mm. Find the ratio of throat area necessary. The reservoir conditions are given as P_o= 1 atm ; T_o=200°C. Find also the maximum mass flow rate through the nozzle. What will be the exit pressure and temperature ? **8**

2. (a) What are Laminar Flow air foils ? Explain it briefly. **4**

   (b) Describe in brief the velocity profile of Laminar and Turbulent Boundary layers. Explain which has higher value of (i) Skin friction drag and (ii) Drag due to separation of boundary layer, and why ? **6**

3. (a) What are the flow losses that are suffered by a compressible flow in variable area ducts ? How does the back pressure affect the losses ? 4

(b) A normal shock moves in a constant area tube. In the region ahead of the shock, V_1= 200 m/s, T_1= 30°C and P_1= 0.8 atm. The shock speed with respect to a fixed co-ordinate system is 600 m/s. Find the fluid properties in the region aft of the moving normal shock. 6

4. (a) What is an expansion Hodograph ? What is its use in supersonic aerodynamics ? 4

(b) A supersonic stream of air at M = 3, T = 300K and P = 1 atm passes through a sudden convex and then a sudden concave corner of turning angle 12° each. Determine Mach number, Temperature and Pressure of flow downstream of the concave corner. 6

5. (a) With a neat sketch explain the concept of Prandtl-Meyer expansion waves. How do flow properties like total pressure and Mach number change across the expansion waves ? 5

(b) Sketch the shock Polar for M=2.0 and explain the method of finding the Mach numbers and shock angles for a turning angle of 5 deg. 5

6. (a) An incident shock wave with wave angle = 30° implinges on a straight wall. If the upstream flow properties are M=2.5, P_1=1 atm, T_1=27°C, calculate the reflected shock wave angle with respect to the wall. 6

(b) Bring out the essential differences between Rayleigh flow and Fanno flow. Give atleast two examples for each type of flow. 4

7. (a) A thin plate of length 1m and width 1m is moving in air along it's length at a speed of 50 m/s. Calculate the total skin friction drag on the plate assuming sea level conditions. 7

(b) Explain why a golf ball is dimpled ? 3

8. (a) State Biot-Savart law and derive an expression for the velocity induced by an infinite Vortex filament at a point, which is at a distance n from the filament. 8

(b) Write short note on down wash. 2

9. (a) Explain the terms 'Bound Vortex', 'Starting Vortex' and 'Horse Shoe Vortex'. 3

(b) Show that for an elliptical wing loading the induced drag is minimum. 7

10. (a) Define De Laval Nozzle. Also describe with figures : 4

(i) Under - expanded Nozzle

(ii) Correctly expanded Nozzle

(iii) Over - expanded Nozzle

(b) Explain with the help of a graph, how variable sweep design eliminates transonic and supersonic drag effects. 6