BAS-015

B.Tech. AEROSPACE ENGINEERING (BTAE)

Term-End Examination

December, 2016

00123

BAS-015 : AERODYNAMICS – II

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any* ***seven*** *questions. Use of scientific calculator is permitted.*

1. (a) Explain the procedure to obtain supersonic nozzle contour for a given Mach number using method of characteristics. *5*

(b) An incident shock wave angle of 35 degrees impinges on a straight wall. If the upstream flow properties are M = 3, P = 1 atm and T = 300 K, calculate the reflected shock wave angle with respect to the wall and the flow properties M, P and T downstream of the reflected shock wave. *5*

2. (a) Differentiate between nozzle and venturi. State the necessary conditions for a choked flow to occur in a nozzle. *5*

(b) A diffuser has exit throat area ratio of 1·5 to 1. The inlet Mach number is 0·8. The initial pressure and temperature are 1 bar and 15°C. Assuming the flow to be isentropic, calculate the following for air : *5*

(i) Exit pressure

(ii) Exit temperature

(iii) Exit Mach number

3. (a) Derive the energy equation for one-dimensional steady compressible flow from first principle. Deduce the isentropic relation between stagnation and sonic conditions for temperature, pressure and density. *6*

(b) Sketch the shock polar for M = 2·5 and explain the method of finding the Mach numbers and shock angles for a turning angle of 5 degrees. *4*

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

(a) What is displacement thickness ?

(b) State the limitations of lifting line theory.

(c) Explain the assumption of horse-shoe vortex.

(d) What is boundary layer ?

(e) Define centre of pressure.

(f) What is shock polar ?

5. (a) Derive the relation between Mach number and flow properties, viz., pressure, temperature and density across a normal shock wave. *5*

(b) State and explain the expression for linearized supersonic pressure coefficient. What are the assumptions made ? Enumerate. *5*

6. (a) Derive the relationship between the ratio of stagnation pressure to static pressure and Mach number for an isentropic flow. Derive the similar relations for temperature and density ratios. *6*

(b) A wedge of variable half angle is kept in a supersonic stream of Mach 2. Determine the maximum half angle up to which attached shock is possible. *4*

7. What is the principle of operation of a typical shock tunnel ? For an oblique shock wave, derive the relationships between the flow parameters in front of the shock and behind the shock. *10*

8. (a) Differentiate between static and stagnation temperatures. *5*

(b) Calculate the velocity of sound and the stagnation temperature of a jet at 300 K. Assume Mach number of 1·2. *5*

9. Derive an expression for velocity of sound in air and show that it is proportional to the square root of absolute temperature of air. *10*