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BAS-015

B.Tech. AEROSPACE ENGINEERING (BTAE)

Term-End Examination

00054

June, 2017

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 how a subsonic nozzle can be a supersonic diffuser. *4*

(b) An aircraft is flying at Mach 1·3 at an altitude of 16000 m (P = 0·15 bar, T = 216 K). The compression in its engine is partly achieved by a normal shock wave standing at the entry of its diffuser. Determine, at the downstream of shock, the

(i) Mach number,

(ii) Temperature of air,

(iii) Pressure of air, and

(iv) Change in entropy across the shock wave. *6*

2. (a) What is the role of sweep back and sweep forward for aircraft wings ? Explain the aerodynamic characteristics of swept wings. 6

(b) Define characteristic Mach number and give its maximum value in air. 4

3. (a) Explain the working principle of a shock tube with necessary sketches depicting pressure variation in the tube. 5

(b) Explain why a converging-diverging configuration is required for the acceleration of flow from subsonic to supersonic conditions. 5

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

(a) What is meant by Fanno flow ?

(b) Define drag divergence Mach number.

(c) What is a Transonic wind tunnel ?

(d) What is Isentropic compressibility ?

(e) Explain the phenomenon of 'Choking' in a nozzle.

(f) What is a Shock polar ?

5. (a) Derive a relation connecting flow turning angle, shock angle and free stream Mach number for oblique shock waves. 5

(b) Define isothermal flow. What are the assumptions made to derive the equations for isothermal flow ? 5

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

(b) Derive an expression for correction factor to be applied to pitot-static probe readings in compressible subsonic flows. 4

7. (a) Explain upper and lower critical Mach numbers. 4

(b) A flat plate of size 1 m × 0·5 m is tested at 1500 kmph at the free stream pressure of 0·8 MPa and temperature 30°C at an angle of attack of 5°. Using linear theory, estimate the lift and drag. 6

8. Derive a general expression for the speed of sound in a compressible gas from first principle. 10

9. Analyse the essential differences between Rayleigh flow and Fanno flow. Give at least two examples for each type of flow. 10
