# Question Paper Code : 31028

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

Fifth Semester

Aeronautical Engineering

AE 2303/AE 53/AE 1303/10122 AE 503 — AERODYNAMICS — II

(Regulation 2008/2010)

Time : Three hours Maximum : 100 marks

Use of gas tables permitted.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write down the Bernoulli's equation for compressible flow.

2. Write the one-dimensional momentum and continuity equations for an adiabatic compressible steady flow with assumptions.

3. What is meant by Detached shock?

4. Write down the Hugonoit relation and explain each term involved in it.

5. What is meant by Reflection and Interaction of Shocks?

6. Bring out two important differences between Rayleigh Flow and Fanno Flow.

7. List out the practical application of linearized two-dimensional supersonic theory.

8. Write down the critical pressure coefficient from the Prandtl-Glauert rule.

9. Define critical Mach number.

10. How camber and aspect ratio of wings affect lift distribution?

11. (a) (i) Derive relationship between the ratio of stagnation pressure to static pressure and Mach number for all isentropic flow. (8)

(ii) Derive an expression connecting area and velocity variations with Mach number for a one-dimensional compressible flow. (8)

Or

(b) (i) Derive a general expression for the speed of sound in a compressible gas from first principle. (10)

(ii) Explain with suitable sketches the effect of pressure ratio on flow in a convergent-divergent nozzle. (6)

12. (a) Derive Prandtl Equation and from that prove that the Mach no. behind normal shock is always less-than one. (16)

Or

(b) (i) Derive the Rankine-Hugonoit pressure density relationship for the shock and explain its significance. (8)

(ii) A normal shock wave moves at a constant speed of 500 m/s into still air at 0° C and 0.7 atm. Determine the static and stagnation conditions present in the air after the passage of wave. (8)

13. (a) (i) A Supersonic Flow with $M_1 = 1.5$, $P_1 = 1 \times 105$ N/m$^2$ and $T_1 = 288$ k is expanded around a sharp corner through a deflection angle of 20°. Calculate $M_2$, $P_2$, $T_2$, $P_{o_2}$ and $T_{o_2}$. (10)

(ii) Distinguish between expansion waves and shock waves. (6)

Or

(b) (i) The exit pressure and Temperature are 125kPa and 20°C respectively as air flows through a 25cm diameter pipe at 1200m$^3$/min. The pipe is 60m long. Assuming the friction factor f = 0.005 estimate the inlet pressure and temperature. (8)

(ii) Air flows above a frictionless surface having a sharp corner. The flow angles and mach number in downstream from the corner are - 60° and 4.0 respectively. Calculate the upstream Mach number for flow angle of 15° clockwise and 15° counter clockwise. (8)

14. (a) (i) Derive linearized pressure coefficient equation. (8)

(ii) A flat plate 1m × 0.5m is tested at 1600 kmph at free stream pressure of 0.7 MPa and temperature 27°C at an angle of attack 5°. Using linear theory estimate lift. (8)

Or

(b) (i) Derive the compressible form of Bernoulli's Equation from one Dimensional Euler's Equation. (6)

(ii) What are the salient features of "Linearized Supersonic flow theory? (10)

15\. (a) (i) Derive the governing equation for transonic flow. (8)

(ii) Derive an expression for the $C_L$ and $C_D$ of a symmetric diamond profile in supersonic flow at small angle of attack. (8)

Or

(b) Explain in detail about transonic Area rule with appropriate diagrams. (16)

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