Reg. No. : ☐☐☐☐☐☐☐☐☐☐☐☐

Question Paper Code : 90073

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Fifth Semester

Aeronautical Engineering

AE 8503 — AERODYNAMICS – II

(Regulations 2017)

Time : Three hours   Maximum : 100 marks

Use of Gas Tables are Permitted.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the basic differences between compressible and incompressible fluid flows?

2. What is critical pressure ratio defined in the flow through a Converging-Diverging nozzle?

3. What do you understand by strong and weak wave?

4. What is shock polar?

5. What are the assumptions made in the analysis of Rayleigh flow process?

6. What do you mean by Mach Reflection?

7. Name and sketch the Supersonic airfoil Profiles.

8. What is perturbation Potential?

9. What are the important aerodynamic characteristics of the swept back wings?

10. What is drag divergence Mach Number?

PART B — (5 × 13 = 65 marks)

11. (a) Derive the three dimensional continuity equations for a compressible flow in partial differential form. State the assumptions made. (10+3)

Or

(b) From the fundamental principles derive an expression for speed of sound in terms of ratio of specific heats, gas constant and flow temperatures.

12. (a) Derive the Rankine-Hugoniot equation. What are the applications of Rankine Hugoniot relation? (11+2)

Or

(b) Explain the pressure corrections required while using a pitot tube in supersonic flow for pressure measurements.

13. (a) Discuss in detail the principle and methodology adopted in method of characteristics deriving the necessary equations.

Or

(b) Bringout the essential differences between Rayleigh flow and Fanno flow. Give three examples for each type of flow.

14. (a) Based on small perturbation theory, derive the linearlised velocity potential equation for compressible flow.

Or

(b) Derive suitable expression for lift and drag coefficient of flat plate airfoil at small angles of attach using linearised supersonic flow theory.

15. (a) (i) Write a note on critical mach number and drag divergence mach number. (6)

(ii) Briefly discuss the Area rule and Supercritical aerofoil. (7)

Or

(b) Write a detailed note on Basics of Hypersonic aerodynamics.

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PART C — (1 × 15 = 15 marks)

16. (a) Explain in detail the procedure to be followed for the design of a Supersonic Nozzle using method of Characteristics

Or

(b) Air at $P_1 = 3.4$ bar, $T_1 = 35°C$ enters a circular duct at a Mach number of 0.14 The exit Mach number is 0.6 and coefficient of friction is 0.004. If the mass flow rate is 8.2 Kg/s, determine:

    (i) Pressure, Temperature at the exit.

    (ii) Diameter of the duct

    (iii) Stagnation pressure loss.

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