

Fourth Semester B.Tech Degree Model Question Paper

Branch: Aeronautical Engineering

13.403 FUNDAMENTALS OF AERODYNAMICS

Time:3 hours

Max.Marks: 100

PART: A

(Answer all questions under part A. Each question carries 2 marks)

- 1) Write energy equation for a steady incompressible flow and name the terms involved in the equation.
- 2) Explain Conformal transformation.
- 3) Define Horse shoe vortex?
- 4) Enumerate the application of thin airfoil theory
- 5) Differentiate between normal shock wave and oblique shock wave.
- 6) What is meant by Fanno Flow?
- 7) Differentiate between Mach wave and Shock wave
- 8) Define drag divergence Mach number.
- 9) Name and sketch various supersonic files.
- 10) What is meant by transonic area rule? (10 x 2 = 20 marks)

PART: B

(Answer one question from each module, Each question carries 20 marks each)

Module 1

- 11) Derive the three dimensional continuity equation for a compressible flow. State the assumptions made (20 marks)

Or

- 12) a) Derive the expressions for stream function and velocity potential function (10 marks)
b) Explain source, sink, free and forced vortex with neat sketches (10 marks)

Module 2

- 13) a) Explain how the Joukowski's transformation is used to obtain a circular aerofoil (16 marks)
b) Explain Kutta condition (4 marks)
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Or

- 14) Derive the fundamental equation for thin airfoil theory and give the assumptions that are made in thin aerofoil theory. (20 marks)

Module 3

- 15) a) Bring out the essential differences between Rayleigh flow and Fanno flow. Give at least two examples for each type of flow (8 marks)
b) What is the importance of Rankine-Hugoniot relationship for shock waves? (4 marks)
c) With a neat sketch explain the concept of Prandtle-Meyer expansion waves. How do flow properties like total pressure and Mach number change across the expansion waves. (8 marks)

Or

- 16) a) What is Rayleigh's correction for total pressure measurement in supersonic flows? Why is the correction required? (8 marks)
b) What conditions favour detachment of shock waves in supersonic flows over solid bodies? (8 marks)
c) Explain pressure deflection diagrams (4 marks)

Module 4

- 17) a) Derive the linearized velocity potential equation for compressible flow and based on the equation derived the Prandtl-Glauert rule. (16 marks)
b) Explain the aerodynamic characteristics of swept wings. (4 marks)

Or

- 18) a) Explain small perturbation theory (8 marks)
b) What is meant by transonic area rule (8 marks)
c) Explain mach waves and mach angle (4 marks)
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