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Question Paper Code: 1015161

B.E. / B.Tech. DEGREE EXAMINATIONS, NOV/ DEC 2024
Fifth Semester
Aeronautical Engineering
U20AE503 – HIGH SPEED AERODYNAMICS
(Regulation 2020)

Time: Three Hours Maximum: 100 Marks

Answer ALL questions

PART – A (10 x 2 = 20 Marks)

1. Define Calorically perfect gas.
2. Define pressure coefficient and write down the expression for pressure coefficient.
3. What is a shock polar?
4. Define slip line.
5. What is meant by small perturbation theory?
6. What is the use of method of characteristics?
7. Illustrate the need of a supercritical airfoil?
8. Write down the need for swept wings.
9. What is a shock tube?
10. Write down the Blasius equation.

PART – B (5 x 16 = 80 Marks)

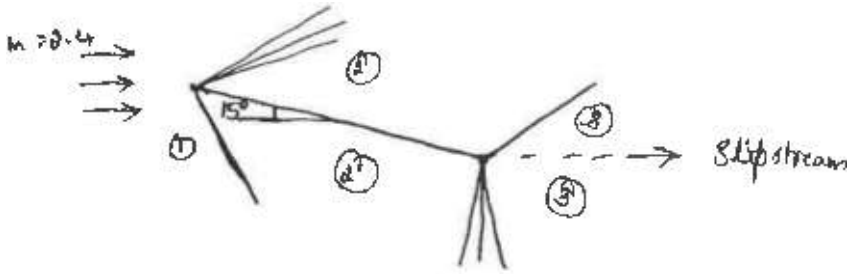
11. (a) Derive area - Mach number relation for convergent divergent passage and explain pressure variation along the passage for different exit pressures and discuss the effect of back pressure in a de Laval nozzle with neat sketches. (16)

(OR)

(b) (i) Air is discharged from a reservoir at Po=6.91bar and To=325^{0}c through a nozzle to an exit pressure of 0.98bar. If the flow rate is 3600 kg/hr determine for isentropic flow. (10)
   (i) Throat area, pressure and velocity
   (ii) Exit area, Mach no
   (iii) Maximum velocity

(ii) Draw the C-D passage for diffuser and nozzles and explain the behavior of it, if the flow is supersonic and subsonic? (6)

12. (a) A flat plate is kept at 15^o angle of attack to a supersonic stream at Mach 2.4 as shown in figure below. Solve the flow field around the plate and determine the inclination of slope stream to the free stream direction using shock expansion theory. (8)



(ii) Derive Rankine-Hugoniot equation. (8)

(OR)

(b) Explain Rayleigh curve with the help of a suitable sketch. Derive the relation for temperature ratio, pressure ratio and density ratio during Rayleigh flow? (16)

13. (a) Explain the small perturbation theory and show the linearization of the potential equation. (16)

(OR)

(b) (i) Derive an expression for linearized pressure coefficient. (8)
(ii) Discuss about the boundary condition to be satisfied for body of revolution. (8)

14. (a) Explain in detail about Drag-divergence Mach number and Transonic area rule. (16)

(OR)

(b) Explain in detail about shock expansion theory and derive an expression for lift and drag equation. (16)

15. (a) Explain in detail about types of high-speed wind tunnel and its advantages and disadvantages? (16)

(OR)

(b) Name the different types of optical flow visualization methods in high-speed wind tunnel. Explain any two with a neat sketch. (16)

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