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Total Number of Pages: 02

B.Tech.
PAE51102

5th Semester Regular Examination 2017-18
Aerodynamics-II
BRANCH: AERO
Time: 3 Hours
Max Marks: 100
Q.CODE: B168

Answer Question No.1 and 2 which are compulsory and any four from the rest.
The figures in the right hand margin indicate marks.

Q1 Answer the following questions: multiple type or dash fill up type (2 x 10)

- a) If ρ is expressible as a function of p only, the fluid having this characteristic are called _____.
- b) When M^* is the ratio of local flow speed and critical speed of sound, then it is called as the _____.
- c) In a stream tube the area – velocity relation can be expressed as _____.
- d) In a nozzle when $p_e < p_b$, the nozzle is said to be _____.
- e) The Mach number behind a normal shock is always _____.
- f) The flow through a normal shock is _____.
 - a) One Dimensional
 - b) Two Dimensional
 - c) Three Dimensional
 - d) All of the above.
- g) _____ is a graphical representation of oblique shock properties.
- h) The rate of change of stream properties along a Rayleigh line is a function of the rate of change of stagnation temperature. (True/False)
- i) Which of the following statement is NOT TRUE across an oblique shock wave?
 - (A) Static temperature increases, total temperature remains constant.
 - (B) Static pressure increases, static temperature increases.
 - (C) Static temperature increases, total pressure decreases.
 - (D) Static pressure increases, total temperature decreases.
- j) Use of _____ not only increases M_{crit} , but also reduces the rate of drag coefficient in transonic flow.

Q2 Answer the following questions: Short answer type

- a) Write continuity equation for a 1-D flow.
 - b) What is internal energy for a gas? Explain.
 - c) Write equation for relations between stagnation pressures, density with Mach number
 - d) What do you mean by steady level flight?
 - e) Define Rayleigh flow
 - f) Write about shock boundary layer interactions?
 - g) Write the difference between the flow over the wedge and cone?
 - h) What are the qualitative aspects of hypersonic flow?
 - i) Write about over expanded flow at the nozzle exit?
 - j) Write about intersection of shocks?
- Q3**
- a) Obtain an equation for continuity? Write continuity equation for 1- D flow? **(10)**
 - b) Air flow is discharged to atmosphere at sea level through a sonic nozzle' If the air storage at the reservoir is $40 \times 10^5 \text{ N/m}^2$, determine the pressure, temperature and density at the exit of the nozzle- Assume that the reservoir air is at sea level temperature? **(5)**
- Q4**
- a) Derive the Rayleigh supersonic pitot formula? **(10)**
 - b) A Pitot tube is inserted in to an air flow of Mach 2 where the static pressure is 1 atm. Calculate the total pressure measured by the tube and. the loss of total pressure experienced. **(5)**
- Q5**
- a) Write about intersection of shocks, Mach reflection? **(10)**
 - b) Explain the concept of prandtl-Meyer expansion around a convex corner and represent in the Hodograph plane. **(5)**
- Q6**
- a) Explain the procedure to obtain supersonic nozzle contour for a given Mach number using method of characteristics. **(10)**
 - b) Explain about whitcombs transonic area rule? **(5)**
- Q7**
- a) Write about intersection of shocks, Mach reflection? **(10)**
 - b) A supersonic flow with $M_1 = 1.5$, $p_1 = 1 \text{ atm}$ and $T_1 = 288\text{k}$ is expanded around a sharp corner through a deflection angle 150° . calculate T_2, V_2 , and the angles that the forward and rearward Mach lines with respect to the upstream flow direction . **(5)**
- Q8**
- a) Give a brief outline of operation of supersonic wind tunnels employing convergent -divergent nozzles? **(10)**
 - b) The nozzle of a supersonic wind tunnel has an exit to throat area ratio of 6.79 when the tunnel is running, a pitot tube mounted in the test section, measures 1.448atm, what is the reservoir pressure for the tunnel. **(5)**
- Q9**
- a) Explain principle of limited upstream influence in supersonic flow? **(10)**
 - b) Calculate L/D ratio for flight conditions of Mach 2.0 at an altitude of 11km. for these conditions the wing angle of attack is 0.035rad, assume chord length of airfoil is 2.2m. **(5)**