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10AE61

Sixth Semester B.E. Degree Examination, June/July 2018
Applied Gas Dynamics

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of gas tables is permitted.***

PART – A

1 a. List the reference velocities used in compressible flow analysis. Define and derive an equation for the following:
(i) Critical Mach number, M*
(ii) Croceo number, Cr. **(08 Marks)**

b. Explain the performance of Dr-Laval nozzle under various back pressures. **(06 Marks)**

c. Air (γ = 1.4, R = 287.43 J/kg.K) enters a straight axisymmetric duct at 300 K, 3.45 bar and 150 m/s and leaves it at 277 K, 2.058 bar and 260 m/s. The area of cross section at entry is 500 cm^2. Assuming adiabatic flow, determine,
(i) Stagnation temperature
(ii) Maximum velocity
(iii) Mass flow rate.
(iv) Area of cross section at exit. **(06 Marks)**

2 a. Derive an expression for Prandtl Meyer relation in gas velocities before and after the normal shock and critical velocity of sound. **(10 Marks)**

b. Air approaches a symmetrical wedge (δ = 15°) at a mach number of 2.0. Determine for the strong and weak waves (i) Wave angle (ii) Temperature ratio and (iii) Downstream mach number. **(10 Marks)**

3 a. Derive an expression for variation of mach number with duct length for a flow in constant area duct with friction. **(06 Marks)**

b. What are fanno lines? Explain with sketch. **(06 Marks)**

c. A circular duct passes 8.25 kg/s of air at an exit mach number of 0.5. The entry pressure and temperature are 3.45 bar and 38°C respectively and the coefficient of friction is 0.15, determine
(i) The diameter of the duct (ii) Length of the duct (iii) Pressure and temperature at exit (iv) Stagnation pressure loss. **(08 Marks)**

4 a. Explain the following with respect to Rayleigh flow:
(i) Constant entropy lines.
(ii) Constant enthalpy lines. **(08 Marks)**

b. The Mach number at the exit of a combustion chamber is 0.9. The ratio of stagnation temperatures at exit and entry is 3.74. If the pressure and temperature of the gas at exit are 2.5 bar and 1000°C respectively determine (i) Mach number, pressure and temperature of the gas or entry (ii) The heat supplied per kg of the gas and (iii) The maximum heat that can be supplied.
Take γ = 1.3 and C_p = 1.218 kJ/kgK **(12 Marks)**

PART – B

5 a. Explain the small perturbation theory and show the linearization of the potential equation . **(10 Marks)**

b. Briefly explain the types of boundary conditions with relevant sketches. **(10 Marks)**

6 a. Explain the following:
(i) Von-Karman rule for transonic flow.
(ii) Glauret-rule for sub sonic and supersonic flow. **(12 Marks)**

b. A given profile has at $M_\infty = 0.29$, the following lift co-efficients:
$C_L = 0.2$ at $\alpha = 3^\circ$
$C_L = -0.1$ at $\alpha = -2^\circ$
where α is the angle of attack, plot the relation where α is the Shoumg $\frac{du}{dL}$ versus M_w upt 1.0. **(08 Marks)**

7 a. With the help of relevant sketches, explain supersonic compression and supersoni expansion. **(10 Marks)**

b. Describe Shock-expansion theory and write the equation for Drag and lift for flat plate an Diamond wedge airfoil. **(10 Marks)**

8 a. What are the objectives of flow visualization? list the methods of flow visualizatio

b. techniques in high speed wind tunnel testing. **(06 Marks)**
With suitable sketch explain the following:
(i) Mach zender interferometer.
(ii) Hot-wire anemometer. **(14 Marks)**

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