USN | | | | | | | | | |

10AE61

Sixth Semester B.E. Degree Examination, June/July 2019
Applied Gas Dynamics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define:
i) Stagnation enthalpy of fluid
ii) Max velocity of fluid. **(04 Marks)**

b. Derive Bernoulli equation for compressible flow and also effect of Mach number on compressibility. **(10 Marks)**

c. A storage chamber of a compressor is maintained at 1.8atm absolute and 20°C. The surrounding ambient pressure is 1atm. Calculate:
i) The velocity with which airflow will take place from the chamber to the outside through a unit area hole.
ii) The mass flow rate per unit area. **(06 Marks)**

2 a. Derive Prandtle-Meyer relation across normal shock wave. **(10 Marks)**

b. Explain supersonic compression and supersonic expansion. **(10 Marks)**

3 a. Derive equation for adiabatic, one dimensional flow with friction in term of M:
i) Stagnation pressure ratio **(05 Marks)**
ii) Impulse function ratio. **(05 Marks)**

b. Air enters a long circular duct (d = 12.5cm, $\bar{f} = 0.0045$) at a Mach number of 0.5, pressure 3 bar and temperature 312K. If the flow is isothermal throughout the duct determine
i) The length of duct required to change M to 0.7
ii) Pressure and temperature of air M = 0.7
iii) The length of the duct required to attain limiting Mach number
iv) State of air at the limiting Mach number **(10 Marks)**

4 a. Explain about constant entropy lines and constant enthalpy lines. **(10 Marks)**

b. The conditions of gas in a combustion chamber at entry are $P_1 = 0.343$bar, $T_1 = 310$K, $C_1 = 60$m/s. Determine the Mach number, pressure, temperature and velocity at the exit if the increase in stagnation enthalpy of the gas between entry and exit 1172.5 kJ/kg. Take for $\gamma = 1.4$.

M	$\frac{P}{P^*}$	$\frac{T}{T_o}$	$\frac{T}{T^*}$	$\frac{T_o}{T_o^*}$	$\frac{C}{C^*}$
0.17	2.306	0.9943	0.154	0.129	0.0665
0.45	1.870	0.9610	0.708	0.612	0.3780

(10 Marks)

PART – B

5 a. Explain small perturbation theory and also derive linearized potential flow equation for compressible flow. **(12 Marks)**

b. Explain boundary conditions for cambered aerofoil at an angle of attack. **(08 Marks)**

6 a. Explain the Gothert similarity rule for three dimensional flow. **(12 Marks)**

b. A given profile has at $M_\alpha = 0.29$. The following lift coefficients.

$C_L = 0.2$ at $\alpha = 3°$

$C_L = -0.1$ at $\alpha = -2°$

Where α is the angle of attack. Plot the relation $\frac{dC_L}{d\alpha}$ vs M_α for the values of M_α upto 1.0. **(08 Marks)**

7 a. Explain shock-expansion theory for diamond wedge aerofoil. **(08 Marks)**

b. Derive an expression for aerodynamic force and co-efficient of cambered aerofoil with finite thickness at a small angle of attack. **(12 Marks)**

8 a. Explain velocity measurement for incompressible, compressible and supersonic flow. **(10 Marks)**

b. Write short notes on:

i) Shadow technique

ii) Shock tube. **(10 Marks)**

* * * * *