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Reg. No. : .....

Name : .....

Seventh Semester B.Tech. Degree Examination, June 2016
(2008 Scheme)
08.703 : GAS DYNAMICS (M)

Time : 3 Hours Max. Marks : 100

***Instruction : Use** of approved Gas Tables **permitted**.*

PART – A

Answer **all** questions. **(10×4 = 40 Marks)**

1. What are the four general equations used in the analysis of compressible flow ?
2. Explain Mach angle and its significance.
3. Differentiate critical speed of sound and stagnation speed of sound.
4. Explain the effect of increase in duct length in fanno flow.
5. Explain isothermal flow in constant area duct with the help of T-S diagram.
6. Prove that the Mach number at maximum enthalpy point on the Rayleigh line is $\frac{1}{\sqrt{\gamma}}$.
7. Explain :
   i) Shock strength
   ii) Shock condensation.
8. What is adiabatic temperature recovery factor ? Explain.
9. Explain with the help of neat sketch the working of kiel probe.
10. Explain stagnation temperature probe.

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PART – B

Answer **one full** question from **each** Module.

Module – I

11. a) Derive energy equation in terms of reference velocities. 8

b) A conical diffuser has an inlet diameter of 40 cm and exit diameter of 80 cm. Air enters the diffuser with a static pressure of 210 KPa and a static temperature of 40°C. The average velocity of flow at inlet to the diffuser is 270 m/s. Calculate :

i) The mass flow rate.

ii) Properties at the exit section.

iii) Force exerted on the diffuser walls. 12

OR

12. a) Clearly stating the assumptions derive continuity equation as applicable to a control volume. 10

b) A nozzle in a wind tunnel gives a test section Mach number of 3.5. Heated air enters the nozzle from a large source at 300 KPa and 240° C. If the mass flow rate through the test section is 3.5 kg/s, find the pressure, temperature, velocity and area at the throat and exit sections of the nozzle. Assume one-dimensional isentropic flow. 10

Module – II

13. a) Explain fanno Curve with neat sketch. What are the assumptions made in deriving equations for fanno flow ? 8

b) Air is flowing in an insulated duct with friction coefficient f = 0.002 with an inlet velocity of 130 m/s. The temperature and pressure are 400 K and 250 KPa. The diameter of the duct is 116 cm. Find

i) Length of the pipe if stagnation pressure loss is 20%

ii) Pressure, temperature and velocity at a section 3.5 m from the inlet.

iii) Maximum length of the pipe. 12

OR

14. a) Air-fuel mixture enters a combustion chamber with an initial velocity of 150 m/s, pressure of 4 bar and temperature of 410 K. The Mach number at exit of the combustion chamber is 0.8. Taking $\gamma = 1.3$, $C_p = 1.144$ kJ/kgK and calorific value of fuel = 43 MJ/kg, find
    i) The entry Mach number
    ii) Exit temperature and pressure
    iii) Stagnation pressure loss and
    iv) Air-fuel ratio required. 12

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    b) The conditions of a gas ($\gamma = 1.3$, $C_p = 1.22$ kJ/KgK) at the entry of a constant area duct are $M_1 = 0.28$, $T_{01} = 383$ K, $P_{01} = 4.965$ bar. 627 kJ of heat is supplied to the gas. Determine at the exit section, mach number, pressure and temperature of the gas. What is the stagnation pressure loss during heating ? 8

Module – III

15. a) Derive Prandtl-Mayer Equation for a normal shock. 10

    b) An air craft at a Mach number of 1.2 at an altitude of 16000 m (P = 103 m bar, T = 216.65 K). The compression in its engine is partly achieved by a normal shock wave standing at the entry of the diffuser. Determine immediately at the downstream of the shock :
    a) Mach Number
    b) Temperature of the air
    c) Pressure of the air
    d) Stagnation pressure loss. 10

OR

16. Explain the working Principle of the following :
    i) Interferometer.
    ii) Schlieren technique.
    iii) Supersonic pitot tube.
    iv) Constant current hot wire anemometer. 20