

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. - SEMESTER – I • EXAMINATION – SUMMER • 2014

Subject code: 712103N**Date: 19-06-2014****Subject Name: Fluid Mechanics and Gas Dynamics****Time: 02:30 pm - 05:00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Explain the theory of propagation of infinitesimal pressure wave in a medium and derive sonic velocity is equal to $(\partial p / \partial \rho)_s$. **07**
- (b) What is an aerofoil? Define with a sketch the various terms used in aerofoil geometry. **07**
- Q.2** (a) Explain velocity potential ϕ and stream function ψ for two dimensional incompressible potential flow and hence prove Cauchy - Riemann's equation in Cartesian coordinates. **07**
- (b) Explain Source flow, Sink flow and Doublet with figures. **07**
- OR**
- (b) Derive the following from one dimensional steady flow energy equation **07**
 $a^2/(\gamma - 1) + (c^2/2) = (c_{max}^2/2) = a_0^2/(\gamma - 1) = h_0$
- Q.3** (a) Explain flow in constant area duct with heat transfer on (h-s) diagram and explain the different Mach number regions for heating and cooling of gas flow in duct. **07**
- (b) A combustion chamber in a gas turbine plants receives air at 350 K, 0.55 bar and 75 m/s. The air-fuel ratio is 29 and the CV of fuel is 41870 KJ/kg. take $\gamma = 1.4$ and $R = 0.287$ KJ/kg K for the gas determine: **07**
- (i) The initial and final Mach Numbers.
- (ii) Percentage stagnation pressure loss in the combustion chamber.
- OR**
- Q.3** (a) Explain flow in constant area duct with friction on enthalpy-entropy diagram Also represent graphically the variation of stagnation pressure. **07**
- (b) 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 0.005. if the Mach number at the entry is 0.15, determine **07**
- (i) Length of the duct.
- (ii) Pressure and temperature at the exit.
- (iii) Stagnation pressure loss.
- Q.4** (a) Explain the importance of continuity equation. Also derive the continuity equations in Cartesian coordinates system. **07**
- (b) Derive Euler's Momentum equation in Cartesian coordinate system. **07**
- OR**
- Q.4** (a) Write down the Navier-Stokes equations of motion for three-dimensional, unsteady, compressible and viscous flow, also explain the body and pressure forces. **07**
- (b) Derive Euler's equation and Bernoulli's equation for one dimensional incompressible flow. **07**
- Q.5** (a) Derive Rankine-Hugoniot equation for a normal shock wave. **07**

- (b) What is similitude and model testing? Explain geometric, kinematic and dynamic similarity. 07

OR

- Q.5** (a) Define following dimensionless numbers and state their significance for fluid flow problems: Reynold's number, Froude number and Mach number 07
- (b) Explain the different types of hydraulic similarities that exist between a prototype and its model. 07
