Seat No: _____ **Enrollment No: _____**

PARUL UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

M.Tech. Winter 2018 - 19 Examination

Semester: 1 **Date: 11-12-2018**
Subject Code: 203210102 **Time:10:30 am to 01:00 pm**
Subject Name: Advanced Fluid Mechanics **Total Marks: 60**

Instructions:
1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

Q.1 A) Define the following terms: mass density, dynamic viscosity, bulk modulus, kinematic viscosity and vapour pressure. **(05)**

B) Argon is stored in a reservoir at 320 K. Determine the velocity of sound. For Argon take $\gamma = 1.66$ and its molecular weight as 39.94. The universal gas constant is 8314 J/ kmol K. **(05)**

C) Explain continuum hypothesis in brief. **(05)**

Q.2 **Answer the following questions**. (Attempt any three) (Each five mark) **(15)**

A) Explain hydrodynamic boundary layer in detail for a flow over a flat plate

B) Using the basic equations for a normal shock, derive Rankine -Hugoniot equations and show that a normal shock cannot compress the gas to a density 6 times the density on the upstream side.

C) Explain clearly the disturbances produced by a body moving with subsonic speed and also supersonic speed. Give Karman's rules for supersonic flow

D) Discuss with neat sketch and graph, the working of a Convergent- Divergent nozzle fitted with a chamber at exit in which pressure can be varied.

Q.3 A) What do you understand by stagnation state and stagnation properties. **(07)**
Also show that $\frac{T_0}{T} = 1 + \frac{\gamma-1}{2} M^2$.

B) Explain clearly three reference speeds considered in compressible flow. Sketch steady flow adiabatic ellipse based on above and gave the nomenclature on the sketch. **(08)**

OR

B) Derive the Reynold's Transport Theorem. **(08)**

Q.4 A) Explain different types of oblique shock with neat sketch. **(07)**

OR

A) Find the maximum possible velocity which could be obtained by the expansion of air at a temperature of 288 K. What will be the value of critical velocity? Take $\gamma = 1.4$ and consider air at rest. **(07)**

B) A nozzle has to be designed for an exit Mach Number of 1.5 with exit diameter of 0.2 m. Find the ratio of exit area to the throat area necessary. The reservoir condition is given as $P_o = 1$ bar and $T_o = 293$ K. Also determine the maximum mass flow rate through the nozzle, the exit pressure and the exit temperature. Take $\gamma = 1.4$. **(08)**