

**PARUL UNIVERSITY**  
**FACULTY OF ENGINEERING & TECHNOLOGY**  
**M.Tech. Winter 2017 - 18 Examination**

**Semester: 1**  
**Subject Code: 03210104**  
**Subject Name: Advanced Fluid Mechanics**

**Date: 02/01/2018**  
**Time: 2:00pm to 4:30pm**  
**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) For a steady, incompressible, one dimensional viscous fluid flow through a circular pipe, prove that the velocity is maximum at center line of the pipe. (05)  
 B) Discuss about the pressure wave produced by a body moving with (i) subsonic speed and (ii) supersonic speed. (05)  
 C) When does Boundary layer separation takes place? Explain the physics behind the Boundary layer separation phenomenon in brief. (05)
- Q.2** Answer the following questions. (Attempt any three) (Each five mark) (15)  
 A) Explain the physical significance of a Stream Function.  
 B) Sketch steady adiabatic flow ellipse and discuss the same.  
 C) What do you understand by stagnation state and stagnation properties?  
 Also show that  $\frac{T_0}{T} = 1 + \frac{\gamma-1}{2} M^2$ .
- D) Explain clearly how Fanno line can be plotted on the h-s diagram considering basic equations valid for a flow with friction.
- Q.3** A) Explain in brief about the boundary layer formation for the external flow past a flat surface. (07)  
 B) Derive the general form of continuity equation in Cartesian coordinate system. (08)
- OR**
- B) A source with volume flow rate  $0.2 \text{ m}^3/\text{s}$  and a vortex with strength  $1 \text{ m}^2/\text{s}$  are located at the origin. Determine the equations for velocity potential and stream functions. What would be the resultant velocity at  $x = 0.9 \text{ m}$  and  $y = 0.8 \text{ m}$ . (08)
- Q.4** A) Explain the characteristics of a Turbulent flow. (07)
- OR**
- A) How is an oblique shock generated? For an oblique shock, discuss the following with sketches, (07)  
 (i) Attached and detached shocks (ii) Strong and Weak Shocks  
 (iii) Reflection of shocks (iv) Interaction of shocks
- B) Derive the general form of Reynolds Transport Theorem and explain its significance. (08)