BACHELOR OF ENGINEERING (MECH. ENGG.) 1ST YR 1ST SEM EXAMINATION 2019

FLUID MECHANICS - II

Time: Three hours **Full Marks: 100**

*Answer any **FIVE** questions. All the parts of a question should be answered together.*
Assume any relevant data if necessary with suitable justifications.
Symbols carry their usual meanings.

1. (a) Derive velocity profile for steady laminar flow through pipe.
   b) Show that laminar friction factor for pipe flow is given by $f = 64/\mathrm{Re}$. **[12+8]**

2. a) What are differences between ideal fluid and real fluid?
   b) Show that stream function orthogonally intersects velocity potential function.
   c) Finds stream functions and velocity components for ideal flow over a solid cylinder. **[3+7+10]**

3. a) Discussion the growth of boundary layer over a plate flat.
   b) Explain nominal, displacement and momentum thicknesses of boundary layer flow.
   c) Compute displacement and momentum thicknesses using nominal thickness for the linear velocity profile. **[7+7+6]**

4. a) Write down the Prandtl's boundary layer equation, and derive von Karman's momentum integral equation. What is the use of this equation?
   b) Discuss the development of flow separation. **[13+7]**

5. a) Find the speed of propagation of weak pressure wave through a compressible fluid under adiabatic condition.
   b) Establish area–velocity relationship of compressible flow. What is the use of convergent-divergent nozzle? **[10+10]**

6. a) Derive an expression between the Mach numbers of supersonic and subsonic flow for the normal shock.
   b) Discuss the zone of silence and zone of action for different values of Mach number. **[10+10]**

7. a) Classify different types of unsteady flow. Find an expression of flow velocity with time for the establishment of flow in the pipe connected at the bottom of a reservoir.
   b) The drag force (F) resisting the motion of a sphere of diameter (D), moving with uniform velocity (V) through a fluid depends on the fluid viscosity (μ), fluid density (ρ), velocity (V) and diameter (D). Find from dimensional analysis the fundamental relationship between these variables. **[(3+10)+7]**

8. a) For laminar flow of an oil having dynamic viscosity $\mu = 1.766\ \mathrm{Ns/m^2}$ in a 0.3 m diameter pipe, the velocity distribution is parabolic with a maximum point of 3 m/s at the centre of the pipe. Calculate the shearing stress at the pipe wall and within the fluid 50 mm from the pipe wall.
   b) A normal shock wave takes place during the flow of air at a Mach number of 1.8. The static pressure and temperature of the air upstream of the shock wave are $100kPa\ (abs)$ and 15^0C. Determine the Mach number, pressure and temperature downstream of the shock. **[10+10]**

9. Write short notes on: (any **FOUR**) **[4 × 5]**
   a) Couette flow
   b) Doublet flow
   c) Over-expanded nozzle flow
   d) Causes and effects of turbulence
   e) Water hammer
   f) Magnus effect
   g) von Karman vortex street