B. MECHANICAL ENGG. (EVENING) 1ST YR 1ST SEM SUPPLE EXAMINATION 2017

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 two-dimensional steady laminar flow between two parallel plates.

   b) An oil of specific gravity 0.85 and viscosity 1 Pa s is flowing through a pipe of diameter 0.1 m with maximum of 2 m/s velocity at centre of the pipe. Find Reynolds number, discharge and wall shear stress. [12+8]

2. With appropriate sketches explain nominal, displacement and momentum thicknesses of boundary layer, and also discuss boundary layer growth over a flat plate in details. [2+3+3+12]

3. a) Discuss the phenomena of boundary layer flow separation.

   b) Using von Karman momentum integral equation and zero-pressure gradient over a flat plate, find boundary layer thicknesses (δ, δ^*, θ) over the plate when velocity profile for a laminar flow is given by $\frac{u}{u_\infty} = \frac{y}{\delta}$. [8+12]

4. a) Define source flow and doublet flow along with their mathematical definitions.

   b) Using the method of superposition, simulate a complex flow consisting of uniform flow and doublet. Obtain stream function, velocity components and stagnation points for it. [8+12]

5. a) Find an expression for the speed of propagation of pressure wave through an adiabatic compressible fluid.

   b) Formulate area–velocity relationship for compressible flow through a duct of variable flow-area. From it set the condition for achieving supersonic flow. [10+10]

6. Discuss the expansion process of compressible gas through a convergent-divergent nozzle. What is choking?

   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. [13+7]

7. Write short notes on: (any **FOUR**) [4 × 5]
   a) Hydrodynamically smooth and rough surfaces
   b) Hydraulic transients
   c) Mach number and Mach cone
   d) Vortex flow
   e) Water hammer
   f) Causes and effects of turbulence
   g) von Karman vortex street
   h) Free vortex and force vortex