Code No: I2104/R16

M. Tech. I Semester Regular/Supple Examinations, Jan/Feb-2018

ADVANCED FLUID MECHANICS

Common to Thermal Engineering (21) and Thermal Sciences and Energy Systems (18)

Time: 3 Hours **Max. Marks: 60**

Answer any FIVE Questions
All Questions Carry Equal Marks

1. a Discuss the common features and differences between stream and velocity potential functions. [4]
   b Derive the momentum equation for the steady incompressible fluid flow. [8]

2. a Distinguish between (i) convective and local accelerations; (ii) tangential and normal accelerations. [4]
   b For a plane Poisuelle flow, prove that average velocity is two-thirds of the centerline velocity. [8]

3. a In a generalized Couette flow, is it possible to have a non-zero shear stress between the plates. Under what conditions is it possible? [4]
   b Two horizontal plates are 2 cm apart and one plate moves horizontally at 1 m/s. The space between the plates is filled with an oil of viscosity 1.5 poise. The pressure difference is 12.5 kPa per 10 m length. Sketch the velocity and shear stress distribution. [8]

4. a Distinguish between the characteristics of laminar and turbulent boundary layers. [4]
   b Derive the formula for the Boundary shear stress and friction drag of a smooth parallel flat plate covered by a laminar boundary layer. [8]

5. a Explain (i) Mean drag coefficient and (ii) Critical Reynolds number with reference to the boundary layer flows. [4]
   b A smooth flat plate of size 6m X 3m is towed in a liquid of density 900 kg/m^3 and viscosity 0.12 poise at a uniform velocity of 2.5 m/s. The motion is parallel to the 6m side of the plate. What is the length of the pipe over which the boundary layer is laminar? Calculate the surface drag on both sides of the plate. [8]

6. a Distinguish between hydrodynamically smooth and rough boundaries. [4]
   b An oil of relative density 0.805 and viscosity 0.1 poise flows through a smooth pipe of diameter 5 cm, at the rate of 250 lpm. Determine the thickness of the laminar sub layer, shear velocity and head lost due to friction in 100 m length of the pipe. [8]

7. a Discuss the various methods of controlling the boundary layer. [4]
   b Derive the relation connecting the area-velocity changes and explain the nature of velocity variation with area change, in subsonic, transonic and supersonic flows of the compressible fluid. [8]

8. a How does a compression shock differ from an expansion shock with regard to changing pressures and Mach numbers. [4]
   b Explain with the help of a Temperature-entropy diagram, the different flow regimes in isothermal flow with friction. Evaluate the length of the duct required to attain critical Mach number. [8]

******