M.Tech. Heat Power Engineering (CBCS Pattern) Sem-II

PHPS21 - Fluid Dynamics

P. Pages : 2 **GUG/W/22/11006**

Time : Three Hours * 1 7 9 8 * Max. Marks : 70

Notes :
1. All questions carry equal marks.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Illustrate your answers wherever necessary with the help of neat sketches.
5. Use of slide rule, Logarithmic tables, Steam tables, Mollier's chart, Drawing instruments, Thermodynamic tables for moist air, Psychrometric charts and Refrigeration charts is permitted.
6. Discuss the reaction, mechanism wherever necessary.
7. Answer **any five** questions.

1. a) Derive an expression for acceleration of a particle relative to a fixed reference frame. **6**

b) Simplify the N-S equation for incompressible steady flow in a horizontal pipe, assuming that, $V_z = V_z(r)$, $V_\theta = 0$. Write all three equations. **8**

2. a) Describe Prandtl mixing length theory for finding the shear stress in turbulent flow. **7**

b) In a particular steady state, incompressible flow field, the velocity components are given as $\rightarrow$ **7**

$u = 2xy$ and $v = x^2 - y^2 + c^2$

Find out the stream function to represent this flow.

3. a) What is free vortex? Give some examples of its occurrence show how the velocity & pressure varies with radius in a free vortex flow. **7**

b) For turbulent flow, show that, **7**

$$\frac{\partial u'}{\partial x} + \frac{\partial v'}{\partial y} + \frac{\partial w'}{\partial z} = 0$$

Where u', v' & w' are fluctuations in x, y & z directions.

4. a) Explain the relation between shear stress & pressure gradient for viscous flow. **7**

b) What are the various methods of preventing the separation of boundary layer. **7**

5. a) **7**

The velocity distribution in boundary layer is given by $\frac{u}{U} = \frac{3}{2}\left(\frac{y}{\delta}\right) - \frac{1}{2}\left(\frac{y^2}{\delta^2}\right)$, where δ being the boundary layer thickness. Calculate $\rightarrow$

1) The ratio of displacement thickness to boundary layer thickness (δ^*/δ)
2) The ratio of momentum thickness to boundary layer thickness (θ/δ)

b) Discuss in brief characteristics of laminar flow? Enumerate the examples of laminar flow. **7**

6. a) Discuss the phenomenon of streamlined & Bluff bodies with the help of neat sketch. **7**

b) Sketch the velocity profile for the flow with adverse pressure gradient & explain the flow of separation. **7**

7. a) Explain Semi-empirical theories of similarity hypothesis for turbulent flow. **7**

b) Derive the general velocity distribution equation for turbulent flow in pipes. **7**

8. a) Sketch the steady & unsteady turbulent velocity components & show that 1 & 2 components exists due to turbulent effects, even in parallel flow. **7**

b) Discuss in brief $\rightarrow$ **7**

1) Pressure drag & friction drag.

2) Bluff body & streamline body.

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