

(Following Paper ID and Roll No. to be filled in your Answer Book)

**PAPER ID : 4070**

Roll No.

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## B.Tech.

THIRD SEMESTER EXAMINATION, 2005-2006

### FLUID MECHANICS

Time : 3 Hours

Total Marks : 100

- Note :**
- (i) Attempt **ALL** questions.
  - (ii) All questions carry equal marks.
  - (iii) In case of numerical problems assume data wherever not provided.
  - (iv) Be precise in your answer.

1. Attempt **any two** parts of the following : **(10x2=20)**
- (a) (i) Discuss effect of temperature and pressure on the physical properties of the fluid.
  - (ii) Derive an expression for capillary rise or fall when a small dia tube dipped in to a liquid.
  - (b) (i) Prove that the centre of pressure is always below the centre of gravity for vertical or inclined plane surfaces.
  - (ii) A wooden cylinder of sp. gravity = 0.60 and circular in cross-section is required to float in oil of sp. gravity = 0.80. Find the H/D ratio for the cylinder to float with its longitudinal axis vertical in oil, where H is the height of cylinder and D is its diameter ?

(c) Describe Buckingham's  $\pi$ -theorem. Why this theorem is considered superior over Rayleigh's method for dimensional analysis ?

2. Attempt *any two* parts of the following : (10x2=20)

(a) Discuss geometric, kinematic and dynamic similarities. Are these similarities truly attainable ? If not why ?

(b) (i) Deduce an expression of continuity equation for three dimensional flow.

(ii) Distinguish between forced vortex and free vortex flow.

(c) (i) What is a Pitot tube ? How is it used to measure velocity of flow at any point in a pipe or open channel ?

(ii) Distinguish between the following with neat sketches.

Notches and weirs.

Orifices and mouthpieces.

3. Attempt *any four* parts of the following : (5x4=20)

(a) State the momentum equation. How it is used in determining the force exerted by a flowing liquid on a pipe bend ?

(b) Explain the method for the determination of coefficient of velocity, coefficient of contraction and coefficient of discharge experimentally.

(c) Prove that for laminar flow through a circular pipe, momentum correction factor  $(\beta) = \frac{4}{3}$ .

- (d) A fluid of viscosity  $0.72 \frac{\text{N}\cdot\text{s}}{\text{m}^2}$  and Sp. gravity 1.34 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is given as  $200 \text{N/m}^2$ , find (i) the pressure gradient (ii) the average velocity and (iii) Reynold number of the flow.
- (e) What do you understand by Prandtl's mixing length theory ? Find an expression for shear stress due to Prandtl.
- (f) What do you understand by turbulent flow ? What factor decides the type of flow in pipe ?

4. Attempt *any four* parts of the following : (5x4=20)

- (a) Show that the energy thickness for boundary layer

flow is given by 
$$\delta_E = \int_0^{\delta} \frac{u}{U} \left(1 - \frac{u^2}{U^2}\right) dy$$

- (b) What are the causes of loss of energy in a pipe.
- (c) What do you mean by the separation of boundary layer ? What is the effect of pressure gradient on boundary layer thickness ?
- (d) Discuss and derive an expression for equivalent pipe.
- (e) Define and discuss Hydraulic gradient and total energy lines with neat sketches.
- (f) The 30 cm diameter pipe 2340 m long is connected with a reservoir whose surface is 72 m above the discharging end of the pipe. If for the last 1170 m a second pipe of the same diameter be laid beside the first and connected to it, What would be the increase in the discharge ? Take  $f=0.02$ .

5. Attempt *any two* parts of the following : (10x2=20)
- (a) Explain the phenomenon of water hammer. Obtain an expression for the rise of pressure when the flowing water in a pipe is brought to rest by closing the valve gradually.
  - (b) Define and distinguish with neat sketches between source flow and sink flow.
  - (c) Differentiate between the following :
    - (i) Stream lines body and bluff body.
    - (ii) Friction drag and press drag.

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