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TCE-301

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

**PAPER ID : 4070**

Roll No.

### B. Tech.

(SEM. III) EXAMINATION, 2007-08

### FLUID MECHANICS

Time : 3 Hours]

[Total Marks : 100

- Note :
- (i) Attempt all questions.
  - (ii) Assume missing data suitably, if any, and state the assumptions made.

1 Answer any two parts of the following :  $10 \times 2 = 20$

- (a) (i) State Newton's Law of Viscosity and derive the same.
- (ii) Define surface tension. Establish relationship among surface tension ( $\sigma$ ), pressure within the droplet of liquid in excess of outside pressure ( $p$ ) and dia. of droplet  $d$ .
- (b) (i) Derive an expression for total hydrostatic pressure on curved surfaces.
- (ii) A cone floating in water with its apex downwards has a diameter  $d$  and vertical height  $h$ . If the sp. gravity of the cone is  $s$ , prove that for stable equilibrium

$$h^2 < \frac{1}{4} \left[ \frac{d^2 s^{1/3}}{1 - s^{1/3}} \right]$$



- (c) What do you mean by dimensionless numbers ?  
Name any four dimensionless number and its practical applications in fluid mechanics.

2 Answer any **two** parts of the following : **10×2=20**

- (a) Explain the terms distorted and undistorted models. What is the use of distorted models.
- (b) (i) Define and distinguish between the following Laminar and turbulent flow rotational and irrotational flow.
- (ii) Define stream function and velocity potential function. Prove that stream lines and equipotential lines meet each other orthogonally.
- (c) Derive Bernoulli's equation from Euler's equation of motion along a stream line. Write their practical applications.

3 Answer any **four** parts of the following : **5×4=20**

- (a) Describe momentum equation. Where this equation is used ?
- (b) A 200 mm diameter pipe carries water under a head of 15 meters with a velocity of 3 m/sec. If the axis of the pipe turns through 45°, find the magnitude and direction of the resultant force at the bend.
- (c) Prove that the loss of head for the viscous flow through a circular pipe is given by

$$h_f = \frac{3.2 \mu VL}{\gamma d^2}$$

where

$\mu$  = viscosity,  $V$  = average velocity,

$L$  = length of pipe,  $\gamma$  = Sp. weight,

$d$  = diameter of pipe.

- (d) Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of flow.
- (e) Obtain an expression for the velocity distribution for turbulent flow in smooth pipe.
- (f) How would you distinguish between hydrodynamically smooth and rough pipe ?

4 Answer any **four** parts of the following : 4×5=20

- (a) Define displacement thickness. Derive an expression for the displacement thickness.
- (b) Define the following terms with the help of sketch :  
Laminar boundary layer, turbulent boundary layer, Laminar sub layer and Boundary layer thickness.
- (c) What is a syphon ? Where is it used ? Explain its action.
- (d) Describe Reynold experiments to demonstrate the two types of flow.
- (e) Derive Darcy-Weisbach equation.
- (f) Explain the terms with sketches :
  - (i) Pipes in parallel
  - (ii) Equivalent size of the pipe.

5 Answer any **two** parts of the following : 10×2=20

- (a) What is meant by water hammer ? What allowance is usually made for this in penstock design.

- (b) Define the following terms in case of potential flow :
- (i) Uniform flow
  - (ii) Source flow
  - (iii) Sink flow
  - (iv) Free vortex flow.
- (c) What do you understand by the following terms :
- (i) Total drag on body.
  - (ii) Resultant force on a body
  - (iii) Coefficient of drag
  - (iv) Coefficient of lift.
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