(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 : 10×2=20

(a) (i) State Newton's Law of Viscosity and derive the same.

(ii) Define surface tension. Establish relationship among surface tension (σ), 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, μ = viscosity, V = average velocity,
L = length of pipe, γ = 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 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.

(6) Define the following terms in case of potential
(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.