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

PAPER ID: 4070 Roll No. | | | | | | | | | | |

B.Tech.

THIRD SEMESTER EXAMINATION, 2006-07

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 : **(10×2=20)**

(a) (i) Derive Newton's Law of viscosity.

(ii) What is vapour pressure ? What is its significance in flow problems ?

(b) (i) Explain the procedure of finding hydrostatic forces on curved surfaces.

(ii) A cone floating in water with its apex downwards has a diameter d and vertical height h. If the specific gravity of the cone is 3, prove that for stable equilibrium

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

(c) Using Buckingham's π-theorem, show that the velocity through a circular orifice is given by

$$V = \sqrt{2gH}\ \text{fn}\left[\frac{D}{H}, \frac{\rho VH}{\mu}\right]$$

where

H = Head causing flow

D = Diameter of the orifice

μ = Coefficient of viscosity

ρ = mass density

g = Acceleration due gravity

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

(a) (i) Explain the terms : Distorted models and Undistorted models. What are the uses of distorted models ?

(ii) Explain the terms : Path line, Stream line, Stream tube, Streak line and potential line.

(b) (i) The components in a two dimensional flow are

$$u = 8x^2y - \frac{8}{3}y^3, v = -8xy^2 + \frac{8}{3}x^3$$

Show that these velocity components represent a possible case of an irrotational flow.

(ii) What is Flownet ? Describe any one method of drawing flownet.

(c) (i) How will you obtain Bernoulli's equation from Euler equation of motion along a stream line. Write assumptions of Bernoulli's equation.

(ii) Derive an expression for the discharge over a rectangular notch.

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

(a) Write difference between momentum equation and impulse momentum equation, where these equations are used ?

(b) A 45° reducing bend is connected in a pipe line, the diameters at the inlet and outlet of the bend being 500mm and 300mm respectively. Find the force exerted by water on the bend if the intensity of pressure at inlet to bend is 8.5 N/cm^2 and rate of flow of water is 500 litre/sec.

(c) Prove that for laminar flow through a circular pipe, energy correction factor (α) = 2.

(d) Show that the difference of pressure head for a given length of the two parallel plates which are fixed and through which viscous fluid is flowing is given by :

$$h_f = \frac{12\mu VL}{\rho g D^2}$$

where,

μ = viscosity of the fluid.

V = Average velocity

D = Distance between the two plates

L = length of the plates

ρ = mass density

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

(a) What is meant by water hammer ? Derive an expression for the rise of pressure when water flowing in pipe is subjected to sudden closure of valve and pipe is rigid.

(b) Define the following with sketches in case of potential flow :

(i) Uniform flow

(ii) Sink flow

(iii) Source flow

(iv) Free vortex flow

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

(a) What is a syphon ? On what principle it works ?

(b) What do you understand by :

(i) Total drag on a body

(ii) Resultant force on a body

(iii) Coefficient of drag and

(iv) Coefficient of lift

(c) A main pipe divides into two parallel pipe which again forms one pipe. The length and diameter the first parallel pipe are 2000m and 1.0m respectively, while the length and diameter of second parallel pipe are 2000m and 0.8m. Find the rate of flow in each parallel pipe, if total flow in the mains is $3.5 m^3/sec$. The coefficient of friction for each parallel pipe is same and equal to 0.005.

(d) Find the energy thickness for the velocity distribution in the boundary layer given by

$$\frac{u}{V} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$$

(e) What are different methods of preventing the separation of boundary layers ?