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B.Tech Mechanical Engineering / B.Tech Civil Engineering (BTMEVI/BTCLEVI)

Term-End Examination

June, 2011

BIME-004 : FLUID MECHANICS

Time : 3 hours *Maximum Marks : 70*

Note: *Attempt any five questions each question carry **equal** marks. Use of non programmable scientific calculator is allowed.*

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1. Attempt *any two* questions :-

(a) Define and explain the following : **2x7=14**

(i) Viscosity of a fluid

(ii) Velocity potential function

(iii) Stream function

(iv) Centre of pressure.

(b) Define the following and give one practical example for each :

(i) Laminar flow

(ii) Turbulent flow

(iii) Steady flow

(iv) Uniform flow

(v) Critical and super critical flows.

(c) The velocity components in a two dimensional flow field for an incompressible fluid are as follows :

$$u = \frac{y^3}{3} + 2x - x^2 y \text{ and } V = xy^2 - 2y - x^3/3$$

obtain an expression for the stream function ψ.

2. Attempt *any Two* questions : **2x7=14**

(a) What is a manometer ? How are they classified ? Explain any one of them.

(b) Explain the term meta centre' and 'meta centric height'. What are the conditions and equilibrium of a floating body and a submerged body ?

(c) A solid cylinder of diameter 4.0 meter has a height of 3 meters. Find the metacentric height of the cylinder when it is floating in water with its axis vertical. The specific gravity of the cylinder = 0.6.

3. Attempt *any two* questions : **2x7=14**

(a) What is Euler's equation of motion ? How will you obtain Bernoulli's equation from it.

(b) What is pitot tube ? How will you determine the velocity at any point with the help of pitot tube ?

(c) A pipe line carrying oil of specific gravity 0.87, changes in diameter from 200 mm diameter at a position A to 500 mm diameter at a position B which is at a 4 meter higher level. If the pressures at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 litre/s determine the loss of head and direction of flow.

4. Attempt **all** questions : **2x7=14**

(a) State and explain Buckingham's π- theorem. Why this theorem is considered superior over the Rayleigh's method for dimensional analysis ?

(b) The frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by $T = D^5 N^2 \rho \ \phi \left[\frac{\mu}{D^2 N \rho}\right]$. Prove this by method of dimension.

5. Attempt *any two* parts : **2x7=14**

(a) What do you understand by total energy line, hydraulic gradient line, pipes in series, pipes in parallel and equivalent pipe ? Briefly explain them.

(b) What is a compound pipe ? What will be loss of head when pipes are connected in series ?

(c) A pipe line 60 cm diameter bifurcates at a Y-junction into two branches 40 cm and 30 cm in diameter. If the rate of flow in main pipe is 1.5 m^3/s and mean velocity of flow in 30 cm diameter pipe is 7.5 m/s. determine the rate of flow in the 40 cm diameter pipe.

6. Attempt *any two* questions : **2x7=14**

(a) Define displacement thickness. Drive an expression for the displacement thickness.

(b) Define the terms :

(i) Boundary layer

(ii) Boundary layer thickness

(iii) Drag

(iv) Lift and momentum thickness.

(c) Find displacement thickness and momentum thickness for the velocity distribution in the boundary layer given by

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

7. Write short notes on the following : **4x3½ =14**

(a) Venturimeter

(b) Syphon

(c) Energy correction factor for flow through circular pipe.

(d) Water hammer.