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

Term-End Examination

December, 2011 01232

BIME-004 : FLUID MECHANICS

Time : 3 hours *Maximum Marks : 70*

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

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

(a) Explain Newton's law of viscosity and differentiate between dynamic viscosity and kinematic viscosity with their units of measurements.

(b) Determine the intensity of shear of an oil having viscosity = 1 poise. The oil is used for lubricating the clearance between a shaft of diameter 10 cm and its journal bearing. The clearance is 1.5 mm and the shaft rotates at 150 rpm.

(c) What do you mean by single column manometers ? How are they used for the measurement of pressure ?

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

(a) Distinguish between :

(i) Steady flow and Un-steady flow

(ii) Uniform and non-uniform flow

(iii) Rotational and Irrotational flow

(iv) Laminar and Turbulent flow

(b) 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.

(c) Define the terms :

(i) Subsonic flow

(ii) Super sonic flow

(iii) Sonic flow

(iv) Critical and Super critical flow

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

(a) What are the various conditions of stability of submerged and floating bodies ?

(b) What is hydrostatic pressure distribution ? Give one example where pressure distribution is non-hydrostatic.

(c) A pipe line which is 4 m in diameter contains a gate valve. The pressure at the centre of the pipe is 19.6 N/cm^2. If the pipe is filled with oil of specific gravity 0.87, find the force exerted by the oil upon the gate and position of centre of pressure.

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

(a) State Bernoulli's theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's equation from first principal and state the assumptions made for such a derivation.

(b) In a 100 mm diameter horizontal pipe a venturimeter and 0.5 contraction ratio has been fixed. The head of water on the motor when there is no flow is 3 m (gauge). Find the rate of flow for which the throat pressure will be 2 meters of water absolute. The coefficient of discharge is 0.97 Take atmospheric pressure head of 10.3 m of water.

(c) What the difference between a notch and a weir ? What are the advantages of triangular notch over rectangular notch ? Derive an expression for rate of flow in a V- notch.

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

(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) How will you determine the loss of head due to friction in pipes by using ?

(i) Darcy formula

(ii) Chezy's formula

(c) What is a syphon ? On what principle it works ? Explain briefly.

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

(a) What do you mean by separation of boundary layer ? What is the effect of pressure gradient on boundary layer separation ?

(b) For the velocity profile in laminar boundary layer as, $\frac{u}{U} = \frac{3}{2}\left(\frac{y}{\delta}\right) - \frac{1}{2}\left(\frac{y}{\delta}\right)^3$

Find the thickness of the boundary layer and the shear stress 1.5 m from the leading edge of a plate. The plate is 2 m long and 1.4 m wide and is placed in water which is moving with a velocity of 200 mm/s. Take viscosity of water = 0.01 Poise.

(c) For the velocity profile for laminar boundary layer flows given as :

$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$. Find an expression for boundary layer thickness (δ) and shear stress (τ_o).

7. Write short notes on the following : ***Any two*** : **2x7=14**

(a) Dimensional models.

(b) Source, sink and half body.

(c) Scale and Intensity of Turbulence.

(d) Turbulent boundary layer and laminar sub layer.