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**[4857]-1006**

**S.E. (Civil) (Second Semester) EXAMINATION, 2015**

**FLUID MECHANICS-I**

**(2012 PATTERN)**

**Time : Two Hours**

**Maximum Marks : 50**

**N.B. :-** (i) Answer Q. No. 1 or Q. No. 2, Q. No. 3 or Q. No. 4,  
Q. No. 5 or Q. No. 6, Q. No. 7 or Q. No. 8.

(ii) Neat diagrams must be drawn wherever necessary.

(iii) Figures to the right side indicate full marks.

(iv) Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(v) Assume suitable data, if necessary.

1. (a) Explain the necessity of study of fluid mechanics with context to civil engineering application. State Newton's law of viscosity and its application in fluid mechanics. [3]
- (b) What are the application of surface tension and capillarity effect? Derive the equation for excess pressure inside water drop. [3]
- (c) A differential manometer is connected at two points A & B of two pipes as shown in Fig. 1. Pipe A contains liquid of specific gravity 1.6, while pipe B contains liquid of specific gravity 0.8. If the pressure at A & B are  $11.80 \times 10^4 \text{ N/m}^2$  and

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$19.60 \times 10^4 \text{ N/m}^2$ , find the difference in mercury level in the differential manometer. [6]

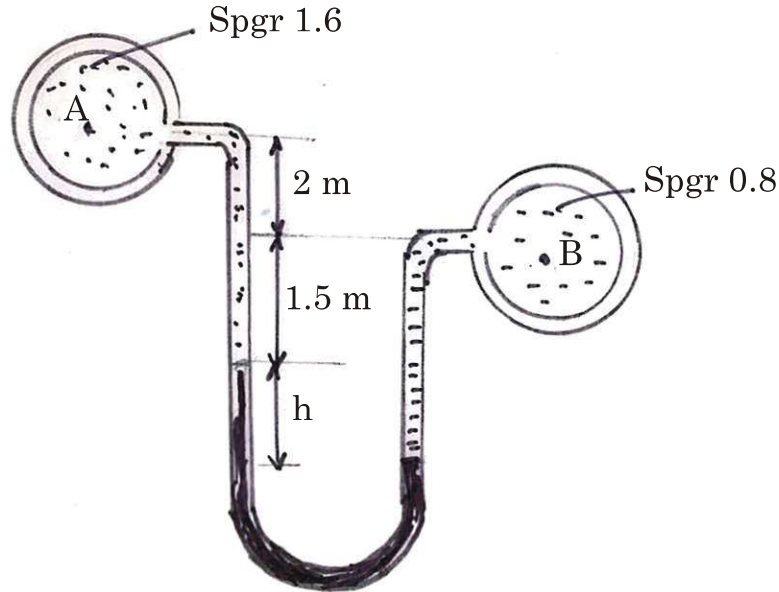


Fig. 1

Or

2. (a) What is dimensional analysis and its uses ? Explain principle of dimensional homogeneity and check dimensional homogeneity of : [3]

$$h_f \frac{fLV^2}{2gd}$$

- (b) Define metacentre and metacentric height. Explain experimental of determining metacentric height of floating bodies. [4]
- (c) A vertical rectangular plane surface has width of 1.5 m and depth of 3.0 m. It is placed in water such that the upper edge is 1 m below free water surface. Find the total pressure and the depth of centre of pressure on the rectangular plane. [5]

3. (a) Define streamline, pathline and streakline. Give mathematical expression for each. [6]
- (b) A stream function is given by  $\phi = 2x^2 - 3y$ . Check if the flow is rotational and satisfies continuity equation. [6]

*Or*

4. (a) Derive the Euler's equation of motion for 1 dimensional flow of an inviscid, incompressible fluid and integrate to obtain Bernoulli equation. [6]
- (b) Explain the necessity of always measuring the pressure difference between inlet and throat of an venturimeter. Explain why  $C_d$  for an orificemeter is considerably less than that of venturimeter. [6]
5. (a) An oil of viscosity 15 poise flows through a pipe of diameter 150 mm at an velocity of 2.5 m/s. If the specific gravity of oil is 0.9, find : [7]
- (1) Pressure gradient in direction of flow
  - (2) Shear stress at the wall of pipe
  - (3) Reynold number of flow of oil
  - (4) Velocity at a distance of 50 mm from wall.
- (b) Explain laminar boundary layer, turbulent boundary layer and laminar sublayer. [6]

*Or*

6. (a) Prove that maximum velocity of flow between two fixed parallel plates and for laminar flow is equal to 1.5 times of average velocity of flow. [6]
- (b) Explain the phenomenon of boundary layer separation. What are the different methods to control boundary layer separation and explain any 2 methods. [7]

7. (a) Explain the condition for development of turbulent flow in pipes and what are the different types of velocity of flow involved in turbulent flow and develop a relationship between them. [6]
- (b) Explain major loss and minor loss that occur in flow through pipe. Show that the loss due to sudden contraction can be expressed as :

$$h_c = k_c \left( \frac{V_2^2}{2g} \right), \quad \text{where} \quad k_c = \left( \frac{1}{c_c} - 1 \right)^2.$$

Explain the variation of  $K_c$  with respect to ratio of diameter of two pipes. [7]

*Or*

8. (a) A 45 m long pipe connects 2 reservoirs, surface of which are exposed to atmosphere, each pipe is 15 m in length, the first and last pipe is 50 mm in diameter and the intermediate pipe is 30 mm in diameter. If the difference in water surface elevation between 2 reservoir is 15 m and friction factor  $f$  for the pipes is 0.005, calculate the flow rate and draw hydraulic gradient and total energy line. [7]
- (b) Explain the determination of friction factor using Moody diagram. [3]
- (c) What are the various types of minor loss that occur in flow through pipes ? Give the equation to measure each of the loss. [3]