

## B.Tech 3rd Semester Exam., 2013

## FLUID MECHANICS

Time : 3 hours

Full Marks : 70

## Instructions:

- (i) The marks are indicated in the right-hand margin.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.
- (v) Assume any suitable data, if required.

1. Answer any seven questions from the following is short, preferably 1 or 2 sentence(s).

What are the following?

14

Fluid

Capillarity

Stoke

Piezometer

Stream tube

Weir

- (a) Hydraulic Grade Line (HGL)
- (b) Stagnation point
- (c) Friction loss in pipe
- (d) Drag force

2. (a) Define the following and give one example of each : 6

- (i) Steady and unsteady flows
- (ii) Uniform and non-uniform flows
- (iii) Laminar and turbulent flows
- (iv) Rotational and irrotational flows

- (b) Calculate the capillary effect in millimeters in a glass tube of 4 mm diameter, when immersed in (i) water and (ii) mercury. The temperature of the liquid is 20 °C and the values of surface tension of water and mercury at 20 °C in contact with air are 0.0735 N/m and 0.51 N/m respectively. The contact angle for water = 0° and for mercury = 130°. Take specific weight of water at 20 °C as equal to 9790 N/m<sup>3</sup>. 8

3. (a) State Newton's law of viscosity and distinguish between Newtonian and non-Newtonian fluids with examples. 6

- (b) A cylinder of 120 mm diameter rotates concentrically inside a fixed cylinder of diameter 125 mm. Both cylinders are 300 mm long. Find the viscosity of the liquid that fills the space between the cylinders if a torque of 0.90 N m is required to maintain a speed of 60 r.p.m. 8
- 4 (a) Define centre of buoyancy and metacentre. Explain stable, unstable and neutral equilibrium of a floating body. 6
- (b) A rectangular pontoon 12 m long and 8 m broad and 3 m deep weighs 800 kN. It carries on its upper deck a boiler 5 m diameter weighing 500 kN. The centre of gravity of the boiler and pontoon may be assumed as their centres of figure and on the same vertical line. Find the metacentric height. Weight of sea water is  $10055 \text{ N/m}^3$ . 8
5. (a) Define laminar flow, turbulent flow, give one example of each and distinguish between streamlines, streak lines and path line: 8

- (b) In a two-dimensional incompressible flow, the fluid velocity components are given by  $u = x - 4y$  and  $v = -y - 4x$ . Show that velocity potential exists and determine its form. Find also the stream function. 8
6. (a) State Buckingham's pi theorem. Explain how dimensionless constants can be framed from a set of variables influencing a phenomenon. What is the utility of Buckingham's theorem? 6
- (b) The discharge  $Q$  over a weir depends on the head of water  $H$ , the acceleration due to gravity  $g$ , the density  $\rho$ , the viscosity  $\mu$ , and the surface tension  $\sigma$ . Obtain an expression for the discharge using Buckingham's pi theorem. 8
7. (a) What are the different energies of a fluid? Explain each of them. 6
- (b) A cylindrical tank 0.9 m in diameter and 2 m high open at top is filled with water to a depth of 1.5 m. It is rotated about its vertical axis at  $N$  r.p.m. Determine the value of  $N$  which will raise water level even with the brim. 8

8. (a) Derive Darcy-Weisbach formula for calculating loss of head due to friction in a pipe. 6
- (b) A pipeline of 600 mm diameter is 1.5 km long. To increase the discharge another line of the same diameter is introduced parallel to the first in the second-half of the length. If  $f = 0.01$  and head at inlet is 300 mm, calculate the increase in discharge. 8
9. Write short notes on any *three* of the following : 14
- (a) Real and Ideal Fluids
  - (b) Circulation and Vorticity
  - (c) Venturi Meter
  - (d) Major Losses in Pipe
  - (e) Syphon

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